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**LOWER CRETACEOUS MICROFAUNA
from
BEAR VILLA "I
ALBERTA**

**Z.F. NIKIFORUK
-1956-**

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THE UNIVERSITY OF ALBERTA

LOWER CRETACEOUS MICROFAUNA

FROM

BEAR VILLA # 1,

ALBERTA

A DISSERTATION

SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

FACULTY OF ARTS AND SCIENCE

DEPARTMENT OF GEOLOGY

by

ZAN FRANK NIKIFORUK

EDMONTON, ALBERTA

APRIL 3, 1956

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L.M. Clark of Pacific Petroleum Ltd. gave the University permission to sample the Bear Villa #1 cores.

J.H. Wall and G.B. Mellon, Research Council of Alberta carried out the actual sampling of the cores.

The drill cuttings from Bear Villa #1 were obtained as a gift to the University of Alberta from Stanolind Oil and Gas Co.

Mrs. E.J. LeBlanc typed the final manuscript.

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ABSTRACT

Sixty-nine specimens of Lower Cretaceous Foraminifera from the Bear Villa #1 Well, located in North Central Alberta, are figured and described. Fifteen genera (8 arenaceous, 7 calcareous) are distinguished in the described microfauna. The arenaceous genera are Ammobaculites, Ammodiscus, Glomospira, Haplophragmoides, Miliammina, Nodosinella, Protonina, and Tritaxia. The calcareous forms are included under the genera, Discorbis, Globulina, Lenticulina, Marginulina, Marginulinopsis, Robulus, and Saracenaria.

On the basis of microfaunal evidence the Clearwater and Joli Fou formations, as developed in Bear Villa #1, are correlated respectively with the Clearwater and Joli Fou formations of the type section along Athabasca River. Correlations are indicated with the Cummings member and basal Lloydminster shale; with the upper part of the Loon River and basal part of the Peace River formations and the Harmon shale and Cadotte members of the Peace River formation.

The basal Clearwater fauna reflects open seaway shallow neritic facies, the middle and upper Clearwater fauna suggest shallow neritic to estuarine facies and the Joli Fou fauna suggests a shallow enclosed bay.

LOWER CRETACEOUS MICROFAUNA

FROM BEAR VILLA #1, ALBERTA

CHAPTER I

INTRODUCTION

Introductory Statement

The Bear Villa #1 Well was drilled by the Bear Oil Co. in 1949, with extensive coring. Cores cut in the Lower Cretaceous formations are of special interest for a micropaleontological study.

Coring started at the top of the Joli Fou formation where only 16 feet of core was cut. An excellent suite of arenaceous foraminifera has been obtained from this section. Coring was resumed within the Grand Rapids formation 40 feet above the top of the Clearwater formation, continuing without gaps to the top of the Paleozoic strata. No microfossils were found in the basal beds of the Grand Rapids formation. Excellent suites of calcareous and arenaceous foraminifera have been obtained from the top 10 and lower 83 feet of the Clearwater formation. The remainder of the Clearwater formation proved to be barren or lacked diagnostic forms.

The microfauna described in this thesis is easily correlated with similar forms from northeastern British Columbia, Peace River, Athabasca River, and Lloydminster areas. All faunas obtained are Albian in age, (uppermost Lower Cretaceous).

Collection and Preparation of Samples

The material used in this study was obtained from wireline cores from the Bear Villa #1 well, cut by Bear Oil Co. in 1949 and stored in the Pacific Petroleum Core-house at Redwater, Alberta. The sampling of the cores was done by Mr. J. H. Wall and Mr. G.B. Mellon, Research Council of Alberta, in August 1955.

The sampling was done by selective picking of sporadic shale intervals where sandy breaks were present, or by taking a composite sample where the entire core was shale. The samples used in this thesis range from 1564 to 2720 feet drilling depths. Stratigraphically this represents an interval from the top of the Joli Fou shale to the top of the Paleozoic strata. Wireline core was available between 1564 and 1582, 2270 and 2720 feet drilling depths. Average core recovery was 72 percent.

Mellon and Wall placed the samples in cotton bags, labelled them, and brought them in to the Department of Geology, University of Alberta.

The writer prepared the samples as follows: approximately half of each sample was placed in a pint sealer, covered with water, labelled and sealed; when the samples had softened sufficiently, they were carefully washed and screened through a set of Tyler screens. The screen set consisted of the following mesh sizes, 28, 48, 80, 100, and 140 mesh to the inch, a collecting pan on the bottom.

The contents of the sealer after a vigorous shaking were emptied on the 28 screen. A small jet of water was directed on the sample until all clay had been washed through. The unbroken residue on the 28 mesh screen was placed in a Waring Blendor (Model PB-5), equipped with a four bladed, light, stainless steel rotor, and the blendor turned on "slow" for two or three minutes (8000 rev/min.). The contents of the blendor were then emptied on the top screen and washed as above. If an appreciable amount of residue still remained it was replaced in the blendor and the process repeated.

The residue on the 48 mesh and succeeding screens was washed by a small jet of water. The clean residue on each screen was transferred to a small muffin tin and dried over a hot plate. The residue in the pan was thoroughly washed by decanting, until all fine clay had been removed and it was also dried. Great care was taken not to burn the samples. Dry samples were placed in screw top glass vials and appropriately labelled.

The dry sample was then poured unto a triangular aluminum tray (wellsite type) in such a manner that a single layer of grains showed up against the silver-grey background. The bottom of the tray was ruled into narrow bands, approximately $1/8$ of an inch wide. This allowed systematic examination of all the particles on the tray.

Picking was carried out under a No. 458149 Leitz binocular microscope. Magnifications of 32 and 48 power were used.

A very fine moistened red sable hair brush (No. 00) was used to transfer the microfossils from the picking tray to the slide. One cell slides were used for mounting. Mounting was done on a black matt surface prepared by applying a solution of gum-tragacanth, with a small amount of formaldehyde. The gum was placed directly on the slide and permitted to dry. The moisture on the wet brush softened the gum sufficiently to permit the fossil to adhere to the slide.

Drawing of Hypotypes, and Plate Making

The hypotypes selected were mounted in single cell slides equipped with plastic cover slips. Outlines of the microfossils were traced on white index cards using a No. 236623 Spencer binocular microscope equipped with a Spencer camera lucida adjusted to magnify 60 times. The detail was filled in with the specimen under a Leitz No. 458149 binocular microscope with a 48 time magnification. Transmitted light and wet specimens were used in drawing all calcareous forms.

The drawings were later photographed and prints made on matt paper. The photographs were then cut out, mounted on black surfaced pasteboard, and retouched to make original plates. The original plates were rephotographed by Kings Studio and Photo Supply and they printed the plates included herein.

Previous Microfaunal Work

A number of foraminiferal suites have been described from stratigraphic horizons equivalent to the ones used in this thesis; that is from the Clearwater and Joli Fou formations and their correlatives.

In 1927, J.A. Cushman published a paper describing some Lower Cretaceous (Upper Cretaceous in his paper) arenaceous foraminifera from several scattered wells in Western Canada. One of the microfossils he described is the important zone fossil Haplophragmoides gigas found throughout most of Western Canada in the Joli Fou shale and its correlatives.

The foraminifera from the Basal Lloydminster and Mannville formations have been described by A.W. Nauss (1947). Forms found in the Basal Lloydminster formation and the Cummings member of the Mannville formation have enabled correlations with the Joli Fou and Clearwater formations respectively.

In an unpublished Ph.D. thesis, at Stanford University, C.R. Stelck (1950) described a partly calcareous suite of foraminifera from the Moosebar formation of upper Pine River, B.C. Some of the forms are similar or identical to the Bear Villa #1 Clearwater forms.

R.T.D. Wickenden (1949) mentions the occurrence of arenaceous foraminifera in the Joli Fou and Clearwater formation. Some of the microfossils are described but no figures were included in the preliminary paper. Wickenden's (1951) paper dealing with the Loon River and Peace River formations is important. In the latter report, a G.S.C. preliminary paper, Wickenden's figures are blue line drawings, and lack certain detail for comparisons. However the writer found Wickenden's figures useful in correlating almost identical suites from Bear Villa #1 with the Peace River section.

Mellon and Wall (1956) published a paper dealing with foraminifera from the McMurray and Clearwater formations. Many of their forms are present in the Bear Villa #1 suites.

Several M.Sc. students at the University of Alberta have made microfaunal studies of equivalent Lower Cretaceous horizons. Bullock (1950) did a microfaunal study of the Basal Lloydminster shale; Bahan (1950) dealt with the Joli Fou foraminifera from Athabasca River; Norris (1951) studied the cutinized microfossils from the Loon River formation from the lower Peace River; Trollope (1951) dealt with the Lower Loon River foraminifera from the Peace River area; Martin (1954) studied the foraminifera of the Clearwater type section; Mellon (1955) dealt with the foraminifera of the McMurray and Clearwater formations of the McMurray area.

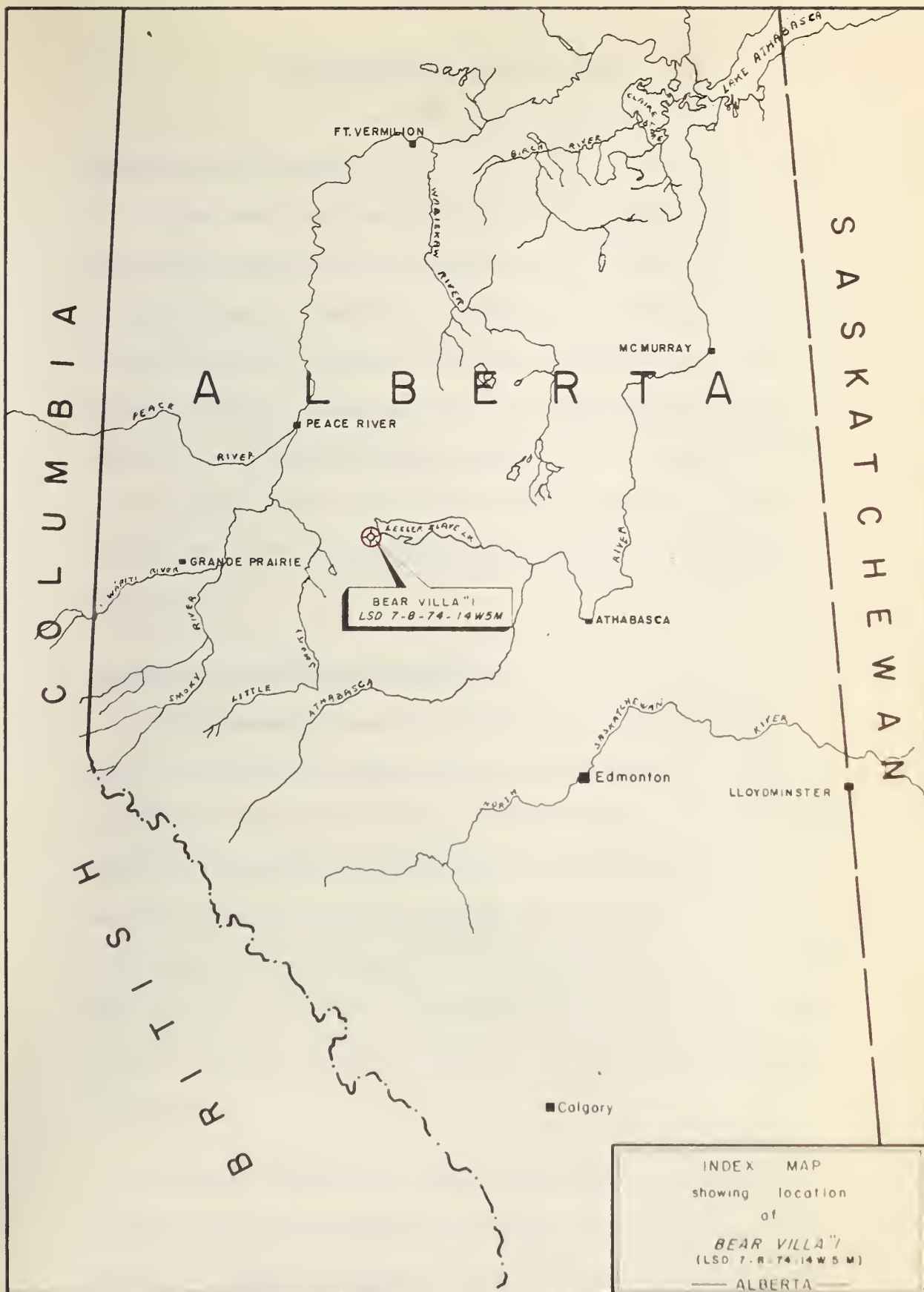


FIGURE 1

CHAPTER II

STRATIGRAPHY and PALEONTOLOGY

Introductory Statement

Close examination of the microfauna present in the Lower Cretaceous section in Bear Villa #1 revealed that the Lower Cretaceous formations, as developed in the well, closely matched the Lower Cretaceous section as exposed along the Athabasca River. On the basis of the above evidence it was decided to use the formational names from the Athabasca River section rather than from the Peace River section; although the Bear Villa #1 well geographically belongs to the Peace River area.

Clearwater and Joli Fou Formations

The Clearwater formation in the type section is about 275 feet thick and outcrops along the Athabasca River from below Grand Rapids to the head of Boiler Rapids. R.G. McConnell (1893) first applied the formational name "Clearwater" to an entirely marine succession of soft, grey and black shales, grey and green sandstones, with some hard concretionary layers. The Clearwater formation is overlain conformably by the Grand Rapids formation and is conformably underlain by the McMurray formation.

Whiteaves (1892) and McLearn (1933) have described the megafauna from the Clearwater formation. The megafauna is stated as ranging throughout the formation and consists of the

ammonoid genera Beudanticeras and Lemuroceras, the pelecypod Inoceramus dowlingi, other pelecypods, and rare gastropods.

Stelck (1950) states that in the Pine River area in British Columbia, Lemuroceras ranges from the lower part of the Gates formation down into the upper part of the Moosebar formation, and in the lower Peace River area in Alberta, Lemuroceras ranges from the basal member of the Peace River formation down into the upper part of the Loon River formation. Stelck in addition recognizes a zone carrying Cleoniceras cf. subbaylei Spath below Lemuroceras in the Loon River formation on the Peace River.

L.J. Martin (1954) and Mellon and Wall (1956) have described a microfauna from the Clearwater formation on the lower Athabasca River. Haplophragmoides gigas minor Nauss, from the Cummings member of the Mannville formation, a diagnostic form, is present in their suites. This form enabled them to correlate type Clearwater suites with the microfauna present in the Cummings member.

The type section of the Joli Fou formation outcrops along the Athabasca River from a short distance below the mouth of Pelican River to about halfway between the Pelican and House Rivers. The Joli Fou formation is about 100 - 110 feet thick at the type section and consists of dark grey non-calcareous shale. It conformably overlies the Grand Rapids formation and by intercalation of sandstone near the top grades into the Pelican sandstone. This shale was originally called the

Pelican shale by McConnell (1893), but Wickenden (1949) changed its name to the Joli Fou shale.

The known megafauna present in the Joli Fou formation consists of poorly preserved specimens of the pelecypod genus Inoceramus. The microfauna present in the Joli Fou formation belongs to the well known Haplophragmoides gigas zone. This zone is easily recognized in wells drilled in most parts of Western Canada.

Correlation with the Athabasca River Section

Martin (1954) and Mellon and Wall (1956) described microfaunal suites from outcrop and subsurface sections of the Clearwater and upper part of the McMurray formations. Comparisons of the above suites with Clearwater suites from Bear Villa #1, showed the suites to be almost identical. Bahan (1951) described the foraminifera from the Joli Fou shale from outcrops along the Athabasca River. Comparison of the Bear Villa #1 Joli Fou foraminiferal suites with those from the outcrop section revealed many forms to be identical or very similar.

The following table gives two lists equating Clearwater and Joli Fou microfossils; one from the Bear Villa #1 subsurface section, and the other from outcrop and subsurface sections along Athabasca River.

Joli Fou formationBear Villa #1Athabasca River SectionAmmobaculites 1564-AAmmobaculites KB-72-6 msAmmobaculites fragmentariusAmmobaculites fragmentariusAmmobaculites tyrrelli var.
1576-EAmmobaculites tyrrelli var.Haplophragmoides gigasHaplophragmoides cf. collyraHaplophragmoides cf. collyraHaplophragmoides 1576-CHaplophragmoides cf. cushmaniMiliammina subellipticaMiliammina MIB-62-81 msClearwater formationBear Villa #1Athabasca River SectionAmmobaculites humeiAmmobaculites humeiAmmodiscus 2478-AAmmodiscus Z-7-54-A msDiscorbis norrissiDiscorbis norrissiGlobulina 2525-AGlobulina Z-7-56-B msGlobulina lacrima canadensisGlobulina lacrima canadensisHaplophragmoides cf. sluzariHaplophragmoides sluzariHaplophragmoides gigas minorHaplophragmoides gigas minorLenticulina bayrockiLenticulina bayrockiMarginulina 2539-BMarginulina Z-7-54-B msMarginulinopsis collinsi var.
2525-BMarginulinopsis collinsiMiliammina subellipticaMiliammina subellipticaSaracenaria 2525-ASaracenaria sp.Saracenaria trollopei var.
2539-ASaracenaria trollopeiTritaxia cf. athabascensisTritaxia athabascensis

Footnote: ms manuscript designation Bahan (1951) (Joli Fou)
ms manuscript designation Martin (1954) (Clearwater)

On the basis of the microfaunal evidence given above the Clearwater formation as developed in Bear Villa #1 correlates exactly with the Clearwater type section exposed along the Athabasca River.

The fauna from the top of the Joli Fou formation is considered to be an upper part of the Haplophragmoides gigas fauna; although Haplophragmoides gigas itself was not identified in the Bear Villa #1 suites. At the same time the fauna is considered to range throughout the whole formation, as developed in Bear Villa #1, although only the top 16 feet was sampled. Therefore on the above evidence the Joli Fou formation in Bear Villa #1 would appear to be coextensive with the Joli Fou type section as exposed along the Athabasca River.

Correlation with the Vermilion Area

Nauss (1947) described the Lower Cretaceous microfossils of the Vermilion area in East-Central Alberta. Haplophragmoides gigas minor Nauss from the Cummings member of the Mannville formation is present in the Bear Villa #1 Clearwater suites. Thus the Clearwater formation from Bear Villa #1 correlates with the Cummings member of the Mannville formation.

Many elements of the Haplophragmoides gigas fauna from the basal Lloydminster shale are present in the Bear Villa #1 Joli Fou suites. Sufficient microfaunal evidence is present to correlate the Joli Fou formation from Bear Villa #1 with the basal Lloydminster shale (i.e. the part of the Lloydminster shale below the Viking sand horizon).

Correlation with the Peace River Section

Trollope (1951) described a microfauna from the middle portion of the Loon River formation. Only a few forms were found in the Bear Villa Clearwater formation suites that were similar to Trollope's forms. Wickenden (1951) described microfossils from the upper part of the Loon River formation and lower part of the Peace River formation. In the same paper he described microfossils from the middle shale (Harmon shale) and Cadotte members of the Peace River formation.

Comparison of the Bear Villa #1 Clearwater formation and Joli Fou formation suites to the suites from along the Peace River revealed many identical or similar forms sufficient for correlation. The following table gives two lists equating the Bear Villa #1 and Peace River locality suites.

<u>Bear Villa #1</u>	<u>Peace River Section</u>
<u>Joli Fou Form.</u>	<u>Middle shale and Cadotte members</u>
<u>Ammobaculites</u> 1564-A	<u>Ammobaculites</u> sp. C.
<u>Ammobaculites</u> 1569-D	<u>Ammobaculites</u> sp. E.
<u>Haplophragmoides</u> 1576-A	<u>Haplophragmoides</u> sp. F.
<u>Haplophragmoides</u> 1576-B	<u>Haplophragmoides</u> sp. H.

<u>Clearwater form.</u>	<u>Loon River formation and lower part of basal member Peace River form.</u>
<u>Ammodiscus</u> 2478-A	<u>Ammodiscus</u> sp. A
<u>Discorbis</u> <u>norrissi</u>	<u>Discorbis</u> 355-B <u>ms</u>
<u>Globulina</u> 2525-A	<u>Globulina</u> sp.
<u>Glomospira</u> 2499-B	<u>Glomospira</u> 311-B <u>ms</u>
<u>Haplophragmoides</u> 2313-A	<u>Haplophragmoides</u> sp.B.
<u>Haplophragmoides</u> 2517-A	<u>Haplophragmoides</u> 424-A <u>ms</u>
<u>Lenticulina</u> <u>bayrocki</u>	<u>Lenticulina</u> sp.
<u>Marginulina</u> 2313-A	<u>Marginulina</u> sp. D.
<u>Marginulina</u> 2517-A	<u>Marginulina</u> sp.A.
<u>Robulus</u> 2525-A	<u>Robulus</u> sp.

Footnote: ms manuscript designation Trollope (1951); all other designations in Peace River section are by Wickenden (1951).

Sufficient microfossil evidence is present to permit correlation of the Clearwater formation as developed in Bear Villa #1 with the upper part of the Loon River formation and the lower part of the basal member of the Peace River formation (equals Falher of Workman et.al. (1954)).

On the basis of the meagre microfossil evidence presented, the age of the Joli Fou shale, as developed in Bear Villa #1, appears to be somewhat similar to that of the middle shale (Harmon) and the basal part of the Cadotte members of the Peace River formation.

Correlation with the Pine River Section

Stelck (1950) described the foraminifera from the basal part of the Moosebar formation in the Pine River area of

British Columbia. Several of Stelck's (1950) calcareous forms are similar to forms in the Bear Villa #1 Clearwater suites, however the arenaceous forms are dissimilar. In as much as, Stelck's (1950) Moosebar fauna was rather poorly preserved, the writer can only suggest a correlation of the Clearwater formation, as developed in Bear Villa #1, with the basal part of the Moosebar formation from the Pine River outcrop area.

Paleoecology

Ecological studies made by Phleger et. al., (1953, 1954, 1955) on Recent foraminiferal assemblages, in the Gulf coast area, served as a basis for the interpretation of the paleoecology of the microfaunal suites from Bear Villa #1. Phleger was able to divide his microfaunal assemblages into four geographical and ecological facies. However the basic distinction is between an open gulf calcareous fauna and an arenaceous near-shore or sound fauna.

The principal factor affecting the distribution of faunas in the San Antonio Bay and Mississippi Sound areas is the presence of off-shore islands. The islands aided by high runoff inhibit the flow of open gulf water into the bay and sound; consequently preventing a mixing of the two faunas. In periods of low runoff the open gulf water may invade the areas behind the barrier islands, thus introducing certain elements of the open gulf fauna.

In case of the absence of a geographic barrier, such as is

illustrated by the southeastern Mississippi Delta area, a transition zone several miles wide separates the typical sound and open/gulf faunas.

The Clearwater sea that flooded the area came in from the north, as it advanced it deposited a basal onlap glauconitic sand (Bluesky). The predominately calcareous microfauna in the basal beds of the Clearwater shale suggest a depositional environment analogous to that of the Mississippi sound area. The glauconite sand is interpreted as forming barrier shoals in the advancing Clearwater sea. The shales containing the calcareous fauna were deposited in a seaward direction from the barrier shoals in normal marine water up to 100 feet deep. The arenaceous counterpart of the calcareous fauna would be found behind the barrier shoals and consequently would be missing in the Bear Villa basal Clearwater suites.

The mixed calcareous and arenaceous fauna in the middle and upper parts of the Clearwater shale suggests a depositional environment analogous to that of the southeastern Mississippi Delta area. There is no evidence to suggest the presence of barrier beaches or shoals. The mixed fauna appears to come from the transition zone separating the two basic facies. Deposition probably took place in water that varied from normal marine to estuarine and less than 60 feet in depth.

The totally arenaceous fauna from the Joli Fou shale suggests deposition in a shallow bay or sound. A high salinity or other abnormal water condition is postulated to explain the

complete absence of calcareous forms. The absence of calcareous forms in the Bear Villa Joli Fou suites cannot be explained by the presence of barrier bars or shoals. Calcareous forms are absent or rare at other Joli Fou localities, and its correlatives; thus suggesting the presence of a shallow landlocked sea or bay during the deposition of the Joli Fou shale and its correlatives.

Further evidence to support the presence of a landlocked sea is the absence of ammonites in the Joli Fou shale. Ammonites are almost world-wide in distribution and undoubtedly would have been present in the Joli Fou sea if there were open seaways.

CHAPTER III

FORMAL DESCRIPTIONS OF MICROFAUNA

Introductory Statement

The species described and figured here were obtained from cores cut in the Joli Fou and Clearwater formations, in Bear Villa #1 Well located in Lsd. 7, Sec. 8, Twp. 74, Rge. 14, W.5 Meridian, Alberta.

The fauna is described in alphabetical sequence, to facilitate locating descriptions when comparing them with the figures in Plates 1 to 5.

Phylum PROTOZOA

Order FORAMINIFERA

Genus AMMOBACULITES Cushman 1910

AMMOBACULITES 1564-A Plate 1, Figure 12

Test very large, robust; early portion close-coiled, slight umbilicus developed, consists of four indistinct chambers; later portion consists of four indistinct chambers in a bent uniserial arrangement, ultimate chamber rather long; sutures obscured in both coiled and uncoiled portions; wall arenaceous of rounded to sub-angular quartz grains with a few chert fragments, averaging .12 mm., held together by minor amount of clear cement, surface of test rough and uneven; aperture terminal, simple; color white with light brown tint.

Length of hypotype 1.35 mm., maximum width .41 mm.

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, Core #1, interval 1564-69 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This form shows a distinct similarity to Ammobaculites KB-72-6 of Bahan (1951) from the centre of the Joli Fou formation. It is also similar to Ammobaculites sp. C. of Wickenden (1951) from the upper part of the Cadotte member but Wickenden's form lacks the rather long ultimate chamber. Ammobaculites 1569-E seems to be a megalospheric form of this species.

Ammobaculites 1569-A
Plate 2, Figure 19

Test large, inflated, early portion planispiral, involute, with 3 or 4 ? chambers, later portion rectilinear, uniserial, consisting of 2 chambers, ultimate chamber sub-pyriform; sutures almost obscured by size of grains, very poorly defined in coiled portion, irregularly oblique in uniserial portion; wall very coarsely arenaceous, consisting of rounded to sub-angular quartz grains, averaging about .16 mm., the grains set in a minor amount of cement resulting in a very rough and irregular test surface; aperture terminal; color grey.

Length of hypotype .93 mm., maximum width .40mm., diameter of coiled portion .38mm.

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, Core #2 interval 1569-71 ft. top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This form could possibly be a megalospheric form of Ammobaculites 1576-A

Ammobaculites obliquus Loeblich and Tappan var 1569-C n. var.
Plate 1, Figure 14

Ammobaculites obliquus Loeblich and Tappan, 1950, University of Kansas Pal. Cont., Protozoa, Art. 3, p. 7, pl. 1, fig. 14a-17.

Test large inflated, early portion planispiral, involute of four chambers, later portion consisting of four chambers in slightly arcuate, uniserial arrangement, ultimate chamber sub-pyriform, tending to overlap on the penultimate chamber; sutures indistinct in early portion, obscured, slightly depressed, oblique in later uniserial portion; wall coarsely arenaceous, of sub-rounded to rounded quartz grains, averaging .13 mm., grains held together by minor amount of cement and finer arenaceous material, amount of fine material increases in younger part of test; surface generally rough; aperture terminal, irregularly rounded opening; color grey.

Length of hypotype 1.21 mm., maximum width .36 mm., diameter of coiled portion .27 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M,

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Alberta, core #2 interval 1569-71 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This variety differs from Ammobaculites obliquus Loeblich and Tappan (1950) in having a very coarse grain size, and being somewhat larger in size.

Ammobaculites 1569-D
Plate 1, Figure 7

Test medium, early portion close-coiled, involute, of three indistinct chambers, later portion consisting of four chambers in straight, rectilinear, uniserial arrangement, chambers becoming somewhat larger as added, ultimate chamber sub-pyriform; sutures almost totally obscured in coiled portion, in uniserial portion indistinct, depressed, at right angles to long axis of test; wall arenaceous, composed of rounded to sub-rounded quartz grains, averaging .08 mm., cemented by minor cement and major fine arenaceous matrix, partly obscuring the grain outlines, surface of test rough with many protruding grains; aperture terminal, simple, at end of stubby robust neck; color grey.

Length of hypotype .88 mm., maximum width .23 mm., diameter of coiled portion .29 mm..

Hypotype Locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #2, interval 1569-71 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species similar to Ammobaculites sp. E. Wickenden (1951) from the Cadotte member, but has fewer chambers in the uniserial portion.

Ammobaculites 1569-E
Plate 1, Figure 13

Test large, early portion consisting of at least two chambers, close-coiled, involute, chambers indistinct, later portion consisting of four chambers in arcuate, bent, uniserial arrangement, ultimate chamber sub-pyriform; sutures almost totally obscured in coiled portion, slightly obscured, depressed at right angles to long axis of test in later portion; wall very coarsely arenaceous, of angular quartz and chert fragments, averaging about .15 mm., held together by minor cement and finer arenaceous material, surface of test rough; aperture terminal, central opening; color grey.

Length of hypotype 1.03 mm., maximum width .45 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #2, interval 1569-71 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This form may possibly be a megalospheric form of Ammobaculites 1564-A.

Ammobaculites torosus Loeblich and Tappan var. 1571-B n. var.
Plate 1, Figure 15

Ammobaculites torosus Loeblich and Tappan, 1949, Jour. Pal.,
Vol. 23, No. 3, p 251, pl. 46, fig. 6a-7.

Test large, compressed, early portion of three chambers close-coiled, involute, later portion consisting of four chambers in slightly arcuate, uniserial arrangement; sutures somewhat obscured, depressed in coiled portion, in uniserial portion distinct depressed at right angles to long test axis; wall coarsely arenaceous, of rounded to sub-angular quartz and few chert grains, averaging about .12 mm., held together by minor amount of cement, surface of test rough; aperture terminal, central opening; color white.

Length of hypotype 1.13 mm., maximum width .38 mm.

Hypotype locality: Bear Villa #1 in Lsd 7-8-74-14 W5M, Alberta, core #3, interval 1571-76 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Differs from Ammobaculites torosus Loeblich and Tappan (1949) in being more coarsely arenaceous and also in having less cement and having a rough finish.

Ammobaculites 1576-A
Plate 1, Figure 10

Test pyritized, medium, early portion close-coiled, involute, of four chambers, later portion consisting of four

chambers in slightly curved, uniserial arrangement, chambers increasing slightly in size as added, ultimate chamber inflated and pyriform; sutures indistinct in coiled portion, in uniserial portion distinct, depressed, at right angles to long axis of test; wall coarsely arenaceous, of angular quartz grain with very few black chert grains, averaging .06 mm., grains neatly covered by a thin smooth outer coating of cement, with an occasional grain showing an uncovered projecting corner; aperture terminal, central; color white, but masked by the pyrite infilling.

Length of hypotype .96 mm., maximum width .31 mm., diameter of coiled portion .26 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species bears some resemblance to Ammobaculites euides Loeblich and Tappan (1950) described from the type Kiowa shale of Kansas; but differs in having a coarse grain size. Ammobaculites 1569-A seems to be a megalospheric form of Ammobaculites 1576-A.

Ammobaculites fragmentarius Cushman
Plate 2, Figures 11, 12

Ammobaculites fragmentaria Cushman, 1927, Royal Soc. Can. Trans., Ser. 3, Vol. 21, pt. 2, sect. 4, p 130, pl. 1, fig. 8.

Test somewhat flattened in fossilization, large, inflated, early portion planispiral, involute with four chambers, later portion consisting of five chambers in straight uniserial arrangement, chambers gradually increasing in size, ultimate chamber very slightly pyriform; sutures poorly defined in coiled portion, in uniserial portion distinct, depressed, at right angles to long axis of test; wall coarsely arenaceous, of angular quartz and very few chert grains up to .11 mm. but averaging about .08 mm., with a small amount of cement giving an uneven finish to the surface of the test; aperture terminal, simple, central, at the end of a pronounced neck; color white with a very light brown tint.

Length of hypotype 1.23 mm., maximum width .36 mm., diameter of coiled portion .20 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is extremely coarse grained; it differs from the holotype in having a pronounced neck. It is almost identical to Ammobaculites fragmentarius of Bahan (1951) from the Joli Fou shale.

Ammobaculites tyrrelli Nauss var. 1576-E
Plate 1, Figure 8

Ammobaculites tyrrelli Nauss, 1947, Jour Pal., Vol. 21, No. 4, p. 333, pl. 48, fig. 2.

Test medium, early portion close-coiled, involute, of three chambers, later portion consisting of four chambers in straight uniserial arrangement, ultimate chamber slightly inflated, and long compared to length of penultimate chamber; sutures indistinct in coiled portion, in uniserial portion distinct, depressed, at right angles to long axis of test; wall arenaceous, of sub-rounded quartz grains, averaging .06 mm., grains neatly fitted in a mozaic with outlines obscured by a thin smooth coating of cement, giving test an glassy pebbled surface; aperture terminal, central opening on a short neck; color grey.

Length of hypotype .96 mm., maximum width .25 mm., diameter of coiled portion .21 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species almost identical to Ammobaculites tyrrelli var. of Bahan (1951) from the Joli Fou shale; it differs in being larger, Bahan's form is .66 mm. in length whereas the Bear Villa form is .96 mm. in length. This variety differs from Ammobaculites tyrrelli Nauss (1947) from the base of the Lloydminster shale, in having the uniserial chambers

more elongate. Ammobaculites 1576-G seems to be a microspheric form; an unfigured form Ammobaculites 1576-I is a megalospheric form; Ammobaculites tyrrelli Nauss var. 1576-E is also a megalospheric form. The relationship of the three forms seems to be of ^{one} trimorphism, the megalospheric form Ammobaculites 1576-I differs from the other megalospheric form in having only three chambers in the uniserial portion and in having a larger coiled portion.

Ammobaculites 1576-G
Plate 1, Figure 9

Test medium, early portion close-coiled, involute, of three chambers, later portion consisting of four chambers in straight, rectilinear, uniserial arrangement, ultimate chamber sub-pyriform; sutures indistinct in coiled portion, in uniserial portion distinct, depressed, at right angles to long axis of test; wall arenaceous, of sub-rounded to rounded quartz grains, neatly fitted together and covered by minor cement and fine arenaceous material, outlines of grains obscured but an occasional grain corner projects through; aperture terminal, central opening, at end of short pronounced neck; color grey.

Length of hypotype .98 mm., maximum width .25 mm., diameter of coiled portion .21 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Almost identical to Ammobaculites tyrrelli Nauss var. 1576-E but has a somewhat shorter ultimate chamber and a more pronounced neck. It seems to be a microspheric form of Ammobaculites tyrrelli Nauss var. 1576-E.

Ammobaculites 1580-B
Plate 1, Figure 11

Test very large, compressed, early portion close-coiled, involute, of three chambers, later portion consisting of three chambers in straight, rectilinear, uniserial arrangement, chambers in uniserial portion inflated; sutures distinct, depressed in early portion, in later portion depressed, obscured, oblique; wall coarsely arenaceous, of angular quartz and very few chert grains, averaging .13 mm., held together by minor cement and finer arenaceous matrix; surface of test rough; aperture terminal, simple opening at end of pronounced neck; color white.

Length of hypotype 1.25 mm., maximum width .51 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #5, interval 1580-82 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Ammobaculites humei Nauss
Plate 3, Figure 12

Ammobaculites humei Nauss, 1947, Jour. Pal., Vol. 21, p. 333, pl.48, fig. 1.

Test stubby, compressed, earlier portion close-coiled,

involute, revealing three chambers, last four chambers in straight uniserial pattern, ultimate chamber slightly inflated; sutures indistinct, in uniserial portion slightly depressed and at right angles to long axis of test; wall arenaceous, consisting of fine to medium quartz grains set in and partly obscured by little clear cement giving an uneven exterior surface; aperture terminal, central; color white.

Length of hypotype .51 mm., width of ultimate chamber .23 mm., maximum diameter of coiled portion .26 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #13, interval 2318-23 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collections.

Remarks: Identical to Ammobaculites humei Nauss, of Martin (1954) from the Clearwater type section and to Ammobaculites humei Nauss, of Mellon and Wall (1956) from the Clearwater formation. Also the same as Ammobaculites humei Nauss (1947) from the Cummings member of the Mannville formation. Ammobaculites humei Nauss var. differs only in having an incipient apertural neck.

Ammobaculites humei Nauss var.
Plate 3, Figure 2

Ammobaculites humei Nauss, 1947, Jour. Pal., vol. 21, p.333, pl. 48, fig. 1.

Test medium, elongate, flattened in preservation, early portion badly distorted, close-coiled, involute, with at least three chambers visible, last six chambers in slightly curved, uniserial pattern, last chamber slightly inflated; sutures obscured in coiled portion, in uniserial portion distinct, depressed, at right angles to long test axis; wall arenaceous, consisting of fine to medium sized quartz grains set in little cement, resulting in an uneven exterior surface; aperture terminal, central opening at end of short incipient neck; color white with a few specks of black carbonaceous? material.

Length of hypotype .71 mm., maximum width .23 mm..

Hypotype locality: Bear Villa #1 in Lsd 7-8-74-8 W5M, Alberta, core #13, interval 2318-23 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Differs from Ammobaculites humei Nauss (1947) only in having an incipient apertural neck.

Ammobaculites humei Nauss
Plate 3, Figure 1

Ammobaculites humei Nauss, 1947, Jour. Pal., vol. 21, p. 333, pl. 48, fig. 1.

Test small, compressed, early portion close-coiled, involute, consisting of three chambers, later portion of four chambers in straight, rectilinear, uniserial arrangement;

sutures very indistinct in coiled portion, chamber distinct in uniserial portion but sutures indistinct, slightly depressed, at right angles to long axis of test; wall arenaceous, of fine to medium quartz grains with a few chert grains, little cement resulting in an uneven exterior surface; aperture terminal, central opening; color white.

Length of hypotype .70 mm.; maximum width .23 mm., diameter of coiled portion .21 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #13, interval 2318-23 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Identical to Ammobaculites humei Nauss (1947) from the Cummings member of the Mannville formation.

Genus AMMODISCUS Reuss 1861

Ammodiscus 2478-A
Plate 4, Figures 14, 15

Test medium sized, planispiral, discoidal, subelliptical in outline, periphery rounded, consisting of an elliptical proloculus and a long undivided second chamber which is coiled in five or six regular convolutions, and overlaps the previous coil by about one half of its own diameter; spiral suture very slightly depressed, not visible until specimen has been moistened; wall finely arenaceous with much cement; aperture crescentic?, at end of second chamber; color white.

Maximum diameter of hypotype .35 mm., minimum diameter .28 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #43, interval 2478-84 ft., middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This form is almost identical to Ammodiscus A-Z-7-54-A Martin (1954) from the middle part of Clearwater type section, and to Ammodiscus sp. A. Wickenden (1951) from the Loon River and lower Peace River formations. It differs in having a somewhat elliptical proloculus; Ammodiscus 2499-A is almost identical but it has a smaller proloculus and is about twice as large.

Ammodiscus 2499-A
Plate 4, Figures 26, 27

Test rather large, discoidal, planispiral, almost circular in outline, consisting of a tiny proloculus and a long undivided second chamber which increases gradually in size during the five or six regular coils, each coil overlaps the previous coil by about one half of its own diameter; spiral suture slightly depressed, distinct; wall finely arenaceous, with much cement giving a glazed appearance to surface of test; aperture crescentic?, at end of second chamber; color white.

Diameter of hypotype .51 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #46, interval 2494-2502 ft., bottom three feet of core, middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Very similar to Ammodiscus 2478-A but has a smaller proloculus and is about twice as large.

Ammodiscus cf. gaultinus Berthelin
Plate 4, Figures 28, 29

Ammodiscus gaultinus Tappan, 1943, Jour. Pal., vol. 17, No. 5, p. 481, pl. 77, fig. 6a-b.

Test rather large, discoidal, planispiral, sub-elliptical in outline, consists of a small ovate proloculus and a long undivided second chamber which increases gradually in size during the six or seven irregular convolutions, a coil will occasionally completely overlap the previous coil hiding it from view; spiral suture distinct depressed; wall finely arenaceous with much cement; aperture open end of the second chamber; color white with a few coils that are light orange.

Maximum diameter of hypotype .66 mm., minimum diameter .48 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #46, interval 2494-2502 ft., bottom three feet of core, middle part of Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species strongly resembles Ammodiscus gaultinus described by Tappan (1943) from the Duck Creek formation of Oklahoma and Texas, in its rather irregular coiling that sometimes overlaps a previous coil, but differs greatly in size; the Duck Creek specimen being .31 mm. in maximum diameter, whereas the Clearwater form is .66 mm. in maximum diameter. The Clearwater form also resembles Ammodiscus kiowensis Loeblich and Tappan (1950) from the type Kiowa shale, but again is of much greater size.

Ammodiscus cf. rotalarius Loeblich and Tappan
Plate 5, Figures 16, 17

Ammodiscus rotalarius Loeblich and Tappan, 1949, Jour. Pal., vol. 23, p. 247, pl. 46, fig. 1.

Test pyritized, discoid, consisting of a spherical proloculus and a long, tubular, undivided second chamber which increases in size very gradually during the three or four regular convolutions, coils very slightly embracing; spiral suture not depressed, not visible until the specimen has been dampened; wall finely arenaceous with much cement; aperture, open end of second chamber; color white but masked by pyrite infilling.

Maximum diameter of hypotype .26 mm., minimum diameter .23 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, bottom half core #51, interval 2525-33 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type
Collection.

Remarks: This species seems to be a megalospheric form of
Ammodiscus rotalaris Loeblich and Tappan (1949) described from
the Lower Cretaceous Walnut formation of Oklahoma.

Genus DISCORBIS Lamarck, 1804

Discorbis norrisi Mellon and Wall var.
Plate 3, Figures 9, 10, 11

Discorbis norrisi Mellon and Wall, 1956, Research Council of
Alta, Rept. No. 72, p. 15, pl. 2, fig. 9, 10, 11.

Test small, trochoid in a left hand spire, consists of a
spherical proloculus and fifteen subsequent chambers, dorsally
convex, ventrally somewhat concave in central area; chambers
distinct, of similar design, gradually expanding as added, not
inflated, all visible from the dorsal side, only last formed
ones visible from the ventral side; sutures distinct, oblique,
flush; wall calcareous, translucent, finely perforate;
aperture a slit at the anterior ventral margin of the last
chamber; color light brown.

Maximum diameter of hypotype .30 mm., minimum diameter
.23 mm..

Hypotype Locality: Bear Villa #1, in Lsd 7-8-74-14 W5M,
Alberta, core #13, interval 2313-18 ft., upper part of Clearwater
formation.

Hypotype: University of Alberta Paleontological Type
Collection.

Remarks: Identical to Discorbis norrisi Wall and Mellon (1956) except in having more chambers and being coiled in a left hand spire, also similar to Discorbis 355-B Trollope (1951), from the upper part of the Loon River formation.

Discorbis cf. norrisi Mellon and Wall
Plate 4, Figures 16, 17, 18.

Discorbis norrisi Mellon and Wall, 1956, Research Council of Alta, Rept. No. 72, p. 15, pl. 2, fig. 9, 10, 11.

Test small, trochoid, dextral, consists of a spherical proloculus and seventeen subsequent chambers, all visible from the dorsal side, only those of the last formed whorl visible on the ventral side, dorsally convex, ventrally slightly concave; chambers distinct, of similar design, gradually getting larger as added; sutures, oblique, flush, distinct; wall calcareous, translucent, finely perforate; aperture a slit at the anterior ventral margin of the ultimate chamber; color light brown.

Maximum diameter of hypotype .33 mm., minimum diameter .28 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #47, interval 2502-04 ft., middle part of the Clearwater formation.

Remarks: This species similar to Discorbis norrisi Mellon and Wall (1956) from the Clearwater formation but has a greater number of chambers and is much larger.

Discorbis norrisi Mellon and Wall
Plate 5, Figures 11, 12, 13

Discorbis norrisi Mellon and Wall, 1956, Research Council of Alta., Rept. No. 72, p. 15, pl. 2, fig. 9, 10, 11.

Test small, trochoid, dextral, dorsal side convex, ventral side slightly concave, consists of two whorls, of a spherical proloculus and about fourteen subsequent chambers; chambers distinct, of uniform shape, gradually expanding as added, not inflated, all chambers visible from the dorsal side, only those of last formed whorl visible from ventral side; sutures oblique, flush; wall translucent, calcareous, finely perforate; aperture a slit at the ventral anterior margin of the last formed chamber; color light brown.

Maximum diameter of hypotype .25 mm..

Hypotype Locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #53, interval 2539-45 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is identical to Discorbis norrisi Mellon and Wall (1956) from the basal Clearwater, but has more chambers, also similar to Discorbis Z-7-56-A Martin (1954) from central part of the Clearwater formation type section.

Genus GLOBULINA d'Orbigny 1839

Globulina 2525-A
Plate 5, Figure 15

Test crushed in preservation, elliptical in outline,

nearly twice as long as broad; no sutures revealed; wall smooth, very finely perforate, calcareous; aperture terminal, radiate, cone-like with numerous long fine radiae; color white.

Length of hypotype .41 mm., maximum width .23 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #51, interval 2525-33 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Identical to Globulina Z-7-56-B Martin (1954) from the type section of the Clearwater formation, but is slightly smaller in size; also the same as Globulina sp. Wickenden (1951) from the lower part of the Peace River and upper part of the Loon River formations.

Globulina lacrima canadensis Mellon and Wall
Plate 5, Figures 9, 10

Globulina lacrima canadensis Mellon and Wall, 1956, Research Council of Alta., Rept. No. 72, p. 16, pl. 2, fig. 6.

Test partly crushed in fossilization, ovoid in cross-section, raindrop shaped, about three or four chambers revealed; sutures flush or very slightly depressed, indistinct; wall calcareous, smooth, very finely perforate; apertural end extended with radiate aperture and small apertural chamber; color hyaline to white.

Length of hypotype .36 mm., maximum width .20 mm..

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Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #53, interval 2539-45 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This lower Clearwater form is identical to Globulina lacrima canadensis Mellon and Wall (1956) from the basal Clearwater and is similar to Guttulina? 20-92A Stelck (1950) from the lower part of the Moosebar formation, and to Globulina Z-7-56-A Martin (1954) from the Clearwater type section.

Genus GLOMOSPIRA Rzehak 1888

Glomospira 2499-B
Plate 4, Figures 3, 4

Test medium sized, roughly elliptical in outline, consists of a long, undivided, tubular second chamber which in the early portion is irregularly coiled in a short knot-like cylinder, that hides the proloculus, later portion tending to become irregularly planispiral, with coils overlapping, about four or five convolutions in early portion, two or three in the later portion; spiral suture distinct, depressed; wall finely arenaceous with much cement; aperture crescentic? at end of second chamber; color white.

Maximum diameter of hypotype .49 mm., minimum diameter .35 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M,

Alberta, core #46, interval 2494-2502 ft., bottom three feet of core, middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species seems to be identical to Glomospira 311-B Trollope (1951) from the upper part of the Loon River formation; but is larger. Glomospira 2499-D seems to be an immature form of this species. Glomospira 8-304-F Stelck (1950) from the Buckinghorse formation does not seem to be related as it lacks the early knot-like portion.

Glomospira 2499-D
Plate 4, Figures 24, 25

Test small, with the outward appearance of a short tilted section from a hangman's knot, consists of a long, undivided, tubular second chamber which is somewhat irregularly coiled in six convolutions, proloculus hidden by coils; spiral suture distinct, slightly depressed; wall very finely arenaceous with much cement; aperture circular, open end of second chamber; color white.

Maximum diameter of hypotype .32 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #46, interval 2494-2502 ft., bottom three feet of core, middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is probably an immature form of Glomospira 2499-A, that is, one that has not developed the later planispiral portion.

Genus HAPLOPHRAGMOIDES Cushman 1910

Haplophragmoides cf. collyra Nauss

Plate 1, Figures 5, 6

Haplophragmoides collyra Nauss, 1947, Jour. Pal., vol. 21, p. 337, pl. 49, fig. 2, 5.

Test pyritized, small sized, planispiral, involute, robust, periphery, broadly rounded, very slightly lobate; chambers distinct of similar wedge-shaped design, seven visible in ultimate whorl; sutures distinct, straight, in radial pattern; wall finely arenaceous, with much clear cement, exterior surface glassy; aperture a rounded arch at the base of the terminal face; color white but masked by the pyrite infilling.

Maximum diameter of hypotype .35 mm., minimum diameter .19 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #3, interval 1571-76 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Haplophragmoides cf. collyra differs from Haplophragmoides collyra Nauss (1947) in that it is smaller and its chambers are not quite as globose. Very close to

Haplophragmoides cf. collyra of Bahan (1951) from the basal part of the Joli Fou formation.

Haplophragmoides 1576-A
Plate 2, Figures 9, 10.

Test flattened in preservation, medium sized, involute, compressed, planispiral, slightly umbilicate, with thickest part of test around umbilical margin, periphery sharply rounded, somewhat lobate; chambers gradually increasing in size, eight being visible in the final whorl; sutures distinct, marked by a thickened ridge along the trace of the septal wall; wall finely arenaceous with very much clear cement, giving a generally smooth or glazed exterior surface; aperture a low arch at base of terminal face; color very light honey brown.

Maximum diameter of hypotype .53 mm., minimum diameter .45 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species shows some similarity to Haplophragmoides sp. F Wickenden (1951) from the middle shale member of the Peace River formation. Haplophragmoides 1580-A is similar to this form but it lacks the lobate periphery.

Haplophragmoides 1576-B
Plate 2, Figures 17, 18

Test pyritized, medium sized, involute, with small, round, deep umbilicus; periphery broadly rounded, lobate; chambers large, wedge-shaped, slightly inflated; sutures very distinct, depressed, straight in radial arrangement; wall arenaceous, of fine to medium quartz grains, much clear cement giving a glazed appearance to surface of test; aperture a rounded low arch at the base of the terminal face; color white but masked by the pyrite infilling.

Maximum diameter of hypotype .60 mm., minimum diameter .45 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is very close to Haplophragmoides sp. H Wickenden (1951) from the Cadotte member of the Peace River formation; it differs in having fewer chambers and being planispiral whereas Wickenden's form is slightly trochoid.

Haplophragmoides 1576-C
Plate 2, Figure 16

Test badly distorted in fossilization, large, involute, planispiral; periphery broadly rounded, lobate; chambers large, inflated, six being visible in the final whorl;

sutures distinct, depressed, straight; wall thin, arenaceous, of medium sized rounded quartz grains, with minor amount of clear cement, not covering the grains, surface of test rough and uneven; aperture a large arched opening at base of terminal face; color white with light brown tint.

Maximum diameter of hypotype .91 mm., minimum diameter .62 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species has a rather thin flexible wall, consequently it is badly distorted during fossilization. It seems identical to Haplophragmoides cf. cushmani of Bahan (1951) from the basal part of the Joli Fou formation. This form is probably much closer to a Haplophragmoides gigas form and should not be referred to Haplophragmoides cf. cushmani form.

Haplophragmoides 1580-A
Plate 2, Figures 14, 15

Test flattened in preservation, medium sized, planispiral, involute, slightly umbilicate with thickest part of test around umbilical margin; periphery sharply rounded; chambers gradually increasing in size, nine being revealed in ultimate whorl; sutures distinct, marked by a ridge along the trace of

the septal walls; wall finely arenaceous with much cement; aperture a high arched slit at the base of the terminal face; color very light honey brown.

Maximum diameter of hypotype .45 mm., minimum diameter .35 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #5, interval 1580-82 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Similar to Haplophragmoides 1576-A except in that it lacks the lobate periphery.

Haplophragmoides 2313-A
Plate 3, Figures 15, 16

Test small, planispiral, involute, very slightly unbilicate, periphery rounded; chambers indistinct, of uniform shape; sutures indistinct, flush or very slightly depressed, gently curved away from umbilical area; wall arenaceous, of fine quartz grains obscured in much cement, surface of test even; aperture a narrow slit at base of terminal face; color brownish.

Maximum diameter of hypotype .43 mm., minimum diameter .30 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #12, interval 2313-18 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species seems to bear some resemblance to Haplophragmoides sp.B Wickenden (1951) from the Loon River and lower part of the Peace River formations, but is smaller in size. Haplophragmoides 2313-A is similar to this species but it has more chambers.

Haplophragmoides 2318-A
Plate 3, Figures 13, 14

Test small, close-coiled, planispiral, with small, shallow, round umbilicus; periphery rounded; chambers wedge-shaped, ten being revealed in ultimate whorl; sutures indistinct, flush, gently curved; wall finely arenaceous, with much cement giving a glassy exterior surface; aperture an arched slit at base of terminal face; color white.

Maximum diameter of hypotype .41 mm., minimum diameter .28 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #13, interval 2318-23 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is similar to Haplophragmoides 2313-A, but has many more chambers.

Haplophragmoides cf. sluzari Mellon and Wall

Plate 3, Figures 21, 22

Haplophragmoides sluzari Mellon and Wall, 1956, Research Council of Alta., Rep. No. 72, p. 17, pl. 1, fig. 10.

Test somewhat distorted in fossilization, small, close-coiled, planispiral, periphery sharply rounded, lobate; chambers distinct, wedge-shaped; sutures distinct, flush in early portion, in later portion raised along the trace of the septal walls; wall finely arenaceous, with much cement, exterior surface smooth; aperture a low arched slit at base of terminal face; color white with light brown tint.

Maximum diameter of hypotype .41 mm., minimum diameter .36 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #13, interval 2318-23 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species may possibly be an immature form of Haplophragmoides sluzari Mellon and Wall (1956), from the basal Clearwater formation; it differs in being of much smaller size and in being involute. It differs in the same way from Haplophragmoides 2-7-56-A of Martin (1954) from the Clearwater type section.

Haplophragmoides 2517-A
Plate 4, Figures 12, 13

Test pyritized, medium sized, compressed slightly, planispiral, not completely evolute, ultimate coil only partly overlapping on previous one; periphery rounded; chambers distinct, nine in the ultimate whorl, six in penultimate; sutures distinct, flush, nearly radial; wall finely arenaceous with much translucent cement; aperture a low arch at base of aperture face of ultimate chamber.

Maximum diameter of hypotype .36 mm., minimum diameter .24 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #50, interval 2517-25 ft., middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This form very strongly resembles Haplophragmoides 424-A Trollope (1951) from the middle portion of the Loon River formation. It differs only in having fewer chambers; it is probably an immature form of Trollope's hypotype.

Haplophragmoides gigas minor Nauss
Plate 5, Figures 5, 6

Haplophragmoides gigas minor Nauss, 1947, Jour. Pal., vol. 21, No. 4, p. 338, pl. 49, fig. 10.

Test pyritized, medium sized, planispiral, completely involute, slightly umbilicate, thickest part of test around the

umbilical margin, periphery sharply rounded, chambers of similar shape, gradually increasing in size, eight being revealed in the ultimate whorl; sutures distinct, sigmoidal, flush in early portion becoming slightly depressed in later portion resulting in a somewhat lobate periphery; wall finely arenaceous, with much cement, giving a glassy pebbled exterior surface; aperture a low arch at the base of the terminal face.

Maximum diameter of hypotype .40 mm., minimum diameter .31 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #51, interval 2517-25 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: The hypotype from the basal part Clearwater figured here, seems almost identical to Haplophragmoides gigas minor Nauss (1947), from the Cummings member of the Mannville formation; to Haplophragmoides gigas minor Nauss, Martin (1954), from the Clearwater type section; and to Haplophragmoides gigas minor Nauss, Mellon and Wall (1956) from the basal Clearwater formation.

Genus LENTICULINA Lamarck 1804

Lenticulina 2313-A
Plate 3, Figures 17, 18

Test medium sized, planispiral, evolute, sides convex,

small transparent umbo in centre, covering proloculus and inside margin of chambers, test consists of spherical proloculus and six subsequent chambers, chambers of similar shape, gradually increasing in size as added, final chamber somewhat inflated; sutures distinct, flush except for last two that are slightly depressed, curved strongly backwards; wall calcareous, unornamented, translucent; aperture at the peripheral angle, partly broken away; color light brown.

Maximum diameter of hypotype .38 mm., minimum diameter .26 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #12, interval 2313-18 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Close to Lenticulina bayrocki Mellon and Wall var. 2525-C.

Lenticulina cf. bayrocki Mellon and Wall
Plate 3, Figures 19, 20

Lenticulina bayrocki Mellon and Wall, 1956, Research Council of Alta., Rept. No. 72, p. 19, pl. 2, fig. 7, 8.

Test medium, lenticular, planispiral, close-coiled, sides strongly convex, periphery subacute, very small, circular, umbonal area of clear shell material at centre, chambers triangular, of uniform shape, gradually getting larger as added, seven chambers revealed in final coil;

sutures flush, distinct, gently curved backwards; wall calcareous, opaque, finely perforate; aperture at the peripheral angle, radiate, partly broken away; color orange.

Maximum diameter of hypotype .60 mm., minimum diameter .53 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #13, interval 2318-23 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Very close to Lenticulina bayrocki Mellon and Wall but has fewer chambers, a subacute periphery whereas Mellon and Wall's species shows an incipient development of a keel.

Lenticulina bayrocki Mellon and Wall var. 2525-C
Plate 5, Figures 1, 2

Lenticulina bayrocki Mellon and Wall, 1956, Research Council of Alta., Rept. No. 72, p. 19, pl. 2, fig. 7, 8.

Test medium sized, planispiral, becoming evolute, small umbonal area of clear shell material covering proloculus, periphery sub-acute to rounded, test composed of a spherical proloculus with seven distinct chambers in the last whorl, chambers similar in shape, but gradually increase in size as added, ultimate chamber inflated; sutures distinct, rather strongly curved backward, flush except ultimate suture which is slightly depressed; wall calcareous, finely perforate?,

translucent; aperture radiate, at the peripheral angle; color white.

Maximum diameter of hypotype .41 mm., minimum diameter .30 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core # 51, interval 2525-33 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Differs from Lenticulina bayrocki Mellon and Wall (1956), in having fewer chambers and showing no development of a keel; it is probably an immature form of Lenticulina bayrocki Mellon and Wall (1956). Lenticulina 2313-A is very close to this variety.

Lenticulina bayrocki Mellon and Wall
Plate 5, Figures 33, 34

Lenticulina bayrocki Mellon and Wall, 1956, Research Council of Alta., Rept. No. 72, p. 19, pl. 2, fig. 7, 8.

Test medium sized, lenticular, planispiral, sides convex, with small not elevated umbo in the centre, of clear shell material, that covers the early chambers and the inside margins of the last formed chambers, periphery rounded, chambers of similar shape, nine visible in the final coil, increasing uniformly in size as added, except for the last two that are slightly inflated and tending to become evolute; sutures distinct, somewhat limbate, flush in early portion, becoming

slightly depressed in later portion, gently curved; wall calcareous, finely perforate; translucent; aperture radial, at the outer peripheral angle; color white.

Maximum diameter of hypotype .58 mm., minimum diameter .45 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #51, interval 2525-33 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This form is identical to Lenticulina bayrocki Mellon and Wall (1956) from the basal Clearwater formation; to Lenticulina Z-7-56-A Martin (1954) from the central part of the Clearwater formation, type section; to Lenticulina sp. Wickenden (1951) from the upper part of the Loon River formation. Lenticulina bayrocki Mellon and Wall var. 2525-C is probably an immature form of Lenticulina bayrocki Mellon and Wall (1956); it differs in having fewer chambers and showing no development of a keel. Lenticulina cf. bayrocki Mellon and Wall is very close to this species but has fewer chambers and a sub-acute periphery.

Genus MARGINULINA d'Orbigny 1826

Marginulina 2313-A
Plate 3, Figures 3, 4

Test small, elongated, earliest portion coiled, later

uncoiling, dorsal periphery convex with development of a rounded incipient keel, ventral margin slightly concave, chambers distinct, earliest four close-coiled, remaining two uncoiled, slightly inflated; sutures distinct, flush, except for ultimate one which is slightly depressed, gently curved; wall calcareous, translucent, without ornament; aperture radiate?, terminal, at the peripheral angle; color amber.

Length of hypotype .31 mm., maximum width .15 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #12, interval 2313-18 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is almost identical to Marginulina sp., D Wickenden (1951) from the lower part of the Peace River formation; it differs only in the development of the incipient keel.

Marginulina 2467-A
Plate 4, Figures 1, 2

Test small, slightly arcuate, ventral margin concave, dorsal margin strongly convex, with a very well developed keel or flange, chambers distinct, ultimate chamber slightly inflated, chambers increasing rapidly in breadth but not in height, later chambers becoming triangular in cross-section; sutures distinct, depressed, gently curved; wall calcareous, without ornament; aperture radiate, at the outer peripheral

angle on a stubby projection; color amber.

Length of hypotype .46 mm., maximum width .21 mm.

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #41, interval 2467-72 ft., middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This form resembles Saracenaria Z-7-56-H Martin (1954) from the Clearwater type section, but Martin's form lacks the well developed flange. Marginulina 2467-B is similar to this form but it is broader and its last formed chambers slant down toward the earlier ones, on the ventral margin.

Marginulina 2467-B
Plate 4, Figures 5, 6

Test small, compressed, earliest portion slightly coiled, rapidly uncoiling; chambers distinct, five in number, not inflated, except the latest ones, that are very slightly so, increasing rapidly in breadth but not in height, reaching back toward the proloculus on the ventral side, forming a curved linear series in doing so; dorsal margin strongly convex with very well developed keel or flange; sutures distinct, oblique, gently curved, last two depressed; wall calcareous, unornamented; aperture radiate, at the outer peripheral angle; color amber.

Length of hypotype .38 mm., maximum width .21 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #41, interval 2467-72 ft., middle part of the Clearwater formation.

Hypotype; University of Alberta Paleontological Type Collection.

Remarks: This species is similar to Marginulina 2467-A but is a broader form in which the last formed chambers slant down, on the ventral margin, toward the earlier chambers.

Marginulina 2478-A
Plate 4, Figures 20, 21

Test tiny, robust, plano-convex in outline, periphery broadly rounded, chambers distinct, three in number, ultimate chamber reaching back on the ventral side to touch the rounded proloculus; sutures distinct, depressed, curved; wall calcareous, unornamented; aperture radiate, at the outer peripheral angle; color orange.

Length of hypotype .31 mm., maximum width .15 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #43, interval 2478-84 ft., middle part of the Clearwater formation.

Hypotype; University of Alberta Paleontological Type Collection.

Remarks: This species could possibly be a very young form

of a Lenticulina, that is one with only the proloculus and the two subsequent chambers formed. Marginulina 2539-C an unfigured form is very similar but has a proloculus and three subsequent chambers. Marginulina 2525-A is an identical but a more robust form.

Marginulina 2517-A
Plate 4, Figures 9, 10

Test large, elongate, slightly arcuate, periphery rounded, ventral margin very slightly concave, dorsal convex, chambers distinct, ovoid in cross-section, five in number, in an arcuate uniserial pattern, not inflated; sutures indistinct in earliest portion becoming distinct and slightly depressed in later portion, oblique; wall calcareous, finely perforate?, ornamented by about eleven or twelve, rather heavy, longitudinal costae, that originate on the proloculus and continue uninterruptedly across the sutures to die out half way up the ultimate chamber; aperture radiate, on a bulbous neck at the peripheral angle; color light honey brown.

Length of hypotype .83 mm., maximum width .31 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #50, interval 2517-25 ft., middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is almost identical with Marginulina 22-146-B Stelck (1950) from the lower Moosebar shales, but is

much larger and lacks the incipient reticulate costae, and is very close to Marginulina sp.A Wickenden (1951) from the Loon River and lower part of the Peace River formations.

Marginulina 2525-A
Plate 4, Figures 22, 23

Test tiny, robust, plano-convex in outline, periphery broadly rounded, test consists of an ovoid proloculus and two subsequent chambers, ultimate chamber reaching back to touch the proloculus, sutures distinct, depressed, curved; wall calcareous, translucent, without ornament; aperture at the outer peripheral angle, radiate; color white.

Length of hypotype .30 mm., maximum width .20 mm.

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #51, interval 2525-33 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Identical to Marginulina 2478-A but is a more robust form.

Marginulina 2533-A
Plate 5, Figures 23, 24

Test small, elongate, earliest portion compressed, coiled, with three chambers visible, uncoiled portion of three chambers, ovoid in cross-section, with last chamber slightly inflated; sutures distinct, oblique, becoming depressed in uncoiled portion; very faint suggestion of longitudinal costae

on uncoiled portion; wall calcareous, smooth; aperture at the peripheral angle, radiate, on a stubby neck; color light honey brown.

Length of hypotype .40 mm., maximum width .15 mm..

Hypotype locality : Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, Core #52, interval 2533-39 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Similar to Marginulina 2539-B but is much smaller, with only incipient development of longitudinal costae and a shorter less pronounced neck.

Marginulina 2539-B
Plate 5, Figures 21, 22

Test stubby, robust, coiled portion compressed with three visible chambers, uncoiled portion of two chambers becoming sub-ovoid in cross-section; chambers indistinct; sutures obscured, flush with surface oblique on uncoiled portion; wall calcareous, finely perforate, opaque, ornamented by about eleven longitudinal costae that originate on the coiled portion and extend uninterruptedly across sutures but terminate half way up the ultimate chamber; aperture terminal, simple?, at end of a pronounced tubular neck; color grey with light brown tint.

Length of hypotype .43 mm., maximum width .19 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #53, interval 2539-45 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Bears a very strong resemblance to Marginulina Z-7-54-B Martin (1950) from the Clearwater, type section, but is much smaller, also Martin's hypotype lacks the pronounced tubular neck. Marginulina 2533-A is a similar form but is smaller, with a shorter, less pronounced neck and only incipient development of longitudinal costae.

Marginulina 2548-A
Plate 5, Figures 7, 8

Test small sized, partly broken, planispiral, circular in outline except for pointed projecting ultimate chamber, dorsal periphery rounded, five coiled chambers make up test; sutures flush, distinct, very gently curved; wall calcareous opaque; aperture at the peripheral angle, radiate; color white.

Length of hypotype .28 mm., maximum width .21 mm.

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #54-55, composite of the two cores, interval 2545-53 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: resembles Cristellaria alta Ehrenberg

Genus MARGINULINOPSIS Silvestri 1904

Marginulinopsis collinsi Mellon and Wall variety 2525-B
Plate 5, Figures 27, 28

Marginulinopsis collinsi Mellon and Wall, 1956, Research Council
of Alta., Rept. No. 72, p. 20, pl. 2, fig. 1, 2.

Test medium sized, earliest portion coiled, later
uncoiling, periphery rounded, ventral margin slightly concave,
dorsal convex, chambers distinct, earliest five coiled,
remaining two uncoiled, not inflated, extremely faint suggestion
of longitudinal costae on uncoiled portion; sutures distinct,
flush with surface, somewhat curved; wall calcareous,
translucent, finely perforate; aperture radiate, at the outside
peripheral angle; color white.

Length of hypotype .55 mm., maximum width .26 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M,
Alberta, core #51, interval 2525-33 ft., lower part of the
Clearwater formation.

Hypotype: University of Alberta Paleontological Type
Collection.

Remarks: Differs from Marginulinopsis collinsi Mellon
and Wall (1956) in having only an extremely faint suggestion
of longitudinal costae and fewer chambers in the uncoiled
portion. It is probably an immature form of Marginulinopsis
collinsi Mellon and Wall. It also differs in the same way
from Marginulina Z-7-54-B Martin (1954).

Genus MILIAMMINA Heron-Allan and Earland 1930

Miliammina subelliptica Mellon and Wall
Plate 1, Figures 1, 2

Miliammina subelliptica Mellon and Wall, 1956, Research Council of Alta., Rept. No. 72, p. 22, pl. 1, fig. 6.

Test elliptical in outline, chambers tubular, distinct, each a half turn in length, added on in irregular quinqueloculine fashion, partly overlapping, three visible on one side, four on the other; sutures rather indistinct, depressed; wall finely arenaceous, translucent cement, pebbled surface appearance; aperture opening at end of very short extension of final chamber; color white.

Length of hypotype .45 mm., maximum width .23 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #2, interval 1569-71 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is identical to Miliammina MIB-62-81 Bahan (1951) from the basal part of the Labiche formation; it also seems identical to Miliammina subelliptica Mellon and Wall from the middle and basal parts of the Clearwater formation.

Miliammina cf. sproulei gigantea Mellon and Wall
Plate 2, Figures 3, 4

Miliammina sproulei gigantea Mellon and Wall, 1956, Research

Council of Alta., Rept. No. 72, p. 21, pl. 1, fig. 1.

Test somewhat elliptical in outline, slightly compressed, chambers a half turn in length in an alternating cyclic arrangement with chambers slightly embracing, five revealed on one side and four on the other; sutures partly obscured, depressed; wall finely arenaceous with much cement; aperture open end of last formed chamber; color white but masked by a patchy coating of black carbonaceous? material.

Length of hypotype .68 mm., maximum width .31 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is identical to Miliammina manitobensis var. C. of Bahan (1951) from the upper part of the Joli Fou formation. It also has a close resemblance to Miliammina sproulei gigantea Mellon and Wall (1956) from the McMurray formation, but is slightly smaller in size. Miliammina 1576-B is close to this form.

Miliammina 1576-B
Plate 2, Figures 1, 2

Test elliptical in outline, slightly compressed, chambers a half turn in length, in an irregular, alternating, cyclic arrangement with an occasional chamber strongly overlapping

the previous one, five chambers visible on one side, six on the other; sutures indistinct, slightly depressed; wall finely arenaceous, with a translucent cement giving a pebbled finish to the surface; aperture open end of final chamber; color white but masked by a patchy coating of black carbonaceous? material.

Length of Hypotype .56 mm., maximum width .31 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Almost identical to Miliammina cf. sproulei gigantea Mellon and Wall (1956), but differs in that the chambers tend to overlap to a greater extent.

Miliammina 1580-A
Plate 2, Figures 7, 8

Test slightly compressed, roughly triangular in cross-section, elongate, chambers distinct, tubular, each a half turn in length, coiled in an irregular quinqueloculine fashion, four chambers visible on one side, three on the other; sutures depressed, distinct; wall finely arenaceous, with a pitted or pebbled appearance; aperture simple, slightly oblique to long axis of test, at end of short pronounced neck which is an extension of the last formed chamber; color very light honey brown.

Length of hypotype .68mm., maximum width .25 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #5, interval 1580-82 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Bears a close resemblance to Miliammina 13-170-C Stelck (1950) from the shales between the second and Third Sikanni sandstones, but is more elongated. Miliammina 1580-B a form with three chambers seems to be an immature form of this species.

Miliammina 1580-B
Plate 1, Figures 3, 4

Test slightly compressed in fossilization, consists of a proloculus and two subsequent chambers, each a half turn in length; sutures depressed, distinct on one side, obscured on the other; wall arenaceous, of fine quartz grains set in a translucent cement, surface pebbled in appearance; aperture round, slightly slanted, at end of a short, somewhat constricted neck, which is an extension of the final chamber; color white.

Length of hypotype .49 mm., maximum width .23 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #5, interval 1580-82 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species seems to be close to Miliammina 1580-A but is much shorter; probably an immature form of Miliammina 1580-A.

Miliammina 2818-A
Plate 3, Figures 5, 6

Test rather elongated, elliptical in outline, chambers long, tubular, each a half turn in length, three chambers visible on one side, four on the other; sutures distinct, depressed; wall finely arenaceous, not an over abundance of cement; aperture simple, at end of a long pronounced neck that is an extension of the last formed chamber; color light orange.

Length of hypotype .68 mm., maximum width .21 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #13, interval 2318-23 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is very close to Miliammina sproulei gigantea Mellon and Wall (1956) from the McMurray formation but is a much more slender form.

Miliammina subelliptica Mellon and Wall

Plate 4, Figures 7, 8

Miliammina subelliptica Mellon and Wall, 1956, Research

Council of Alta, Rept. No. 72, p. 22, pl. 1, fig. 6.

Test elliptical in outline, consisting of a tubular proloculus and two subsequent chambers, of a half turn each, coiled on opposite sides of the proloculus, chambers distinct, overlapping the proloculus to some extent; sutures distinct, depressed; wall finely arenaceous, with translucent cement giving a pebbled finish to the test surface; aperture round, at end of a pronounced tubular slightly constricted neck; color very light brown.

Length of hypotype .55 mm., maximum width .25 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #50, interval 2517-25 ft., middle part of the Clearwater formation.

Hypotype: University of Alberta Palaeontological Type Collection.

Remarks: Identical to Miliammina subelliptica Mellon and Wall (1956) from the Clearwater formation.

Genus NODOSINELLA H.B. Brady 1876

Nodosinella 1576-A
Plate 2, Figures 5, 6

Test large, tapering, elliptical in cross-section, chambers three in number, arranged in straight, rectilinear, uniserial pattern, final chamber large as compared to first

two, and at least two-thirds the length of the entire test; sutures obscure, at right angles to long axis of test; wall very finely arenaceous with much white cement masking the character of the sand grains, smooth; aperture terminal, simple, ovoid; color white.

Length of hypotype .70 mm., maximum width .31 mm.

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #4, interval 1576-80 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Nodosinella 2494-A
Plate 4, Figure 30

Test somewhat flattened in preservation, large, consists of four chambers in curved, uniserial arrangement, chambers increasing suddenly in size as added, last two chambers inflated; sutures partly obscured, slightly depressed, oblique; wall finely arenaceous, with major amount of cement masking the character of the grains, and resulting in a glazed appearance to the surface of the test; aperture terminal rounded central opening; color grey.

Length of hypotype .82 mm., maximum width .45 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #46, interval 2494-2502 ft., bottom three feet of core, middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Nodosinella 2533-A
Plate 5, Figure 14

Test small, flattened in preservation, consists of two small early chambers and a large inflated final chamber, in straight, uniserial arrangement; sutures indistinct, at right angles to long axis of test; wall finely arenaceous, with much cement hiding the grain outlines and giving test surface a glazed appearance; aperture terminal, ovoid opening on a large bulbous projection; color grey.

Length of hypotype .33 mm., maximum width .23 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #52, interval 2533-39 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Genus PROTEONINA Williamson 1858

Proteonina 1564-A
Plate 2, Figure 13

Test flattened in fossilization, a single flask-shaped chamber, with a tapering tubular neck, that differs from the upper portion of the chamber in having a finer arenaceous covering and more cement; neck is straight; maximum diameter of test two-thirds of the length down from the aperture; wall arenaceous, of sub-rounded to angular quartz grains, up to

.13 mm. on main chamber only, neck free of large sand grains; aperture terminal, simple, circular; color white.

Length of hypotype .55 mm., maximum width .33 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #1, interval 1564-69 ft., top of the Joli Fou formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species is almost identical to Proteonina 8-148-A Stelck (1950) from the upper part of the Buckinghorse formation, but is much larger.

Proteonina 2509-A
Plate 4, Figure 19

Test flattened in fossilization, a single spindle-shaped chamber with a straight, tapering, tubular neck that is differentiated from main chamber by change in the angle of taper; wall arenaceous, of sub-rounded quartz grains held together and with outlines obscured by a thin, transparent coat of cement; amount of cement greater and grain size finer on neck, surface of test uneven with pebbly appearance; aperture terminal, central opening at end of neck; color light brown.

Length of hypotype .53 mm., maximum width .11 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #49, interval 2509-17 ft., top two feet of core,

middle part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Proteonina 2533-A
Plate 5, Figure 18

Test a single flask-shaped chamber with a slightly tapering, tubular neck, that is differentiated from the main chamber by a change in the angle of taper and finer arenaceous makeup; neck is straight, one quarter of total length of test; maximum diameter of test one half way down from aperture; wall arenaceous with neatly fitting quartz grains, much cement obscuring the grain outline, and giving a pebbled appearance to the test surface; aperture terminal, simple, at the end of neck; color grey.

Length of hypotype .48 mm., maximum width .30 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #52, interval 2533-39 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Genus ROBULUS Montford 1808

Robulus 2525-A
Plate 5, Figures 31, 32

Test large, biconvex, planispiral, involute, outline nearly circular, biumbonate with distinct umbonal areas of clear shell material, periphery almost acute, with a well

developed, narrow rounded keel, chambers distinct, nine revealed in final whorl, of uniform shape, getting larger very gradually as added; sutures, distinct, somewhat limbate, slightly raised, curving outward from umbo; wall calcareous, finely perforate, translucent, aperture at the outer peripheral angle, radiate, partly broken away; color light honey brown.

Maximum diameter of hypotype .66 mm., minimum diameter .56 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #51, interval 2525-33 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: This species seems almost identical to Robulus sp. Wickenden (1951) from the Loon River and lower part of the Peace River formations; Wickenden's form differs in having a somewhat rounded periphery.

Genus SARACENARIA Defrance 1824

Saracenaria 2313-B
Plate 3, Figures 7, 8

Test small, elongated, dorsal margin strongly convex, close-coiled at base, later chambers showing tendency to uncoil, reaching down on the ventral margin to touch the first formed chambers, last chamber inflated and triangular in cross-section; sutures flush, distinct, gently arcuate; wall translucent, calcareous; aperture radiate?, terminal, at the

peripheral angle; color amber.

Length of hypotype .30 mm., maximum width .18 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #12, interval 2313-18 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Identical to Saracenaria Z-7-56-G var.M described by Martin (1954) from the Clearwater type section, very similar to Saracenaria sp. Mellon and Wall (1956) from the Clearwater formation.

Saracenaria 2525-A
Plate 5, Figures 3, 4

Test medium to small, somewhat elongated, dorsal margin strongly convex, close-coiled at base, later chambers tending to uncoil, slanting down on the ventral margin to touch the proloculus, last formed chambers becoming triangular in cross-section, increasing greatly in breadth but not in height, inflated, six chambers visible, periphery rounded at base, becoming subacute in younger portion; sutures flush, distinct, gently arcuate; wall calcareous, finely perforate, translucent; aperture radiate, terminal, at the peripheral angle; color white.

Length of hypotype .41 mm., maximum width .25 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #51, interval 2525-33 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Identical to Saracenaria sp. Mellon and Wall (1956) from the Clearwater formation. Forms similar to Saracenaria 2525-A have also been described by Martin (1954) from the middle of the Clearwater formation type section and by Stelck (1950) from the lower Moosebar shales. Saracenaria 2539-B is very close to this form but the chambers in the uncoiled portion are not inflated.

Saracenaria 2533-A
Plate 5, Figures 25, 26

Test medium sized, elongate, more or less like a triangular prism, dorsal periphery subacute, chambers six in number, close-coiled at base, later tending to uncoil, last formed chamber of great breadth as compared to height, slanting down on ventral margin to touch the early coiled portion; sutures flush, distinct, gently curved; wall calcareous unornamented, translucent; aperture terminal, radiate, at the peripheral angle, on a small projecting cone; color white with honey brown tint.

Length of hypotype .41 mm., maximum width .18 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M,

Alberta, core #52, interval 2533-39 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Bears a close resemblance to Saracenaria italica Defrance var. politus Khan (1950) from the Lower Gault in Southern England.

Saracenaria trollopei Mellon and Wall var. 2539-A
Plate 5, Figures 29, 30

Saracenaria trollopei Mellon and Wall, 1956, Research Council of Alta., Rept. No. 72, p.25, pl. 2, fig. 26, 27.

Test medium sized, elongated, dorsal periphery subacute, strongly convex in outlines, test consists of seven chambers, close-coiled at the base, final two chambers uncoiled, not inflated, triangular in cross-section; sutures flush, distinct, gently curved; wall calcareous, finely perforate, translucent; aperture terminal, radiate, on a small projecting cone; color white.

Length of hypotype .51 mm., maximum width .28 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #53, interval 2539-45 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Almost identical to the hypotype figured by Wall

and Mellon from the Clearwater formation, differing in having only two chambers in the uncoiled portion. It is probably an immature form of Saracenaria trollopei Mellon and Wall (1956)

Saracenaria 2539-B
Plate 5, Figures 19, 20

Test medium to small sized, with tendency toward elongation, dorsal margin strongly convex, consists of six chambers, close-coiled at base, later showing slight tendency to uncoil, later chambers not inflated, triangular in cross-section, periphery subacute; sutures somewhat limbate, flush distinct; wall smooth, translucent, calcareous; aperture at the peripheral angle, terminal, radiate; color white.

Length of hypotype .33 mm., maximum width .21 mm.

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14, W5M, Alberta, core #53, interval 2539-45 ft., lower part of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Very close to Saracenaria 2525-A but the chambers in the uncoiled portion are not inflated.

Genus TRITAXIA Reuss 1860

Tritaxia cf. athabascensis Mellon and Wall
Plate 4, Figure 11

Tritaxia athabascensis Mellon and Wall, 1956, Research Council of Alta., Rept. No. 72, p. 27, pl. 1, fig. 16, 17.

Test triserial with tendency to become biserial in

youngest portion, somewhat distorted in fossilization so as to appear biserial; test an elongate, trochoid spire of about sixteen or seventeen chambers, only the last seven or eight clearly discernable, chambers rapidly expanding and becoming inflated; sutures depressed in later whorls; wall arenaceous of fine quartz grains set in much cement that results in a smooth exterior surface; aperture terminal, not clearly discernable; color white.

Length of hypotype .66 mm..

Hypotype locality: Bear Villa #1, in Lsd 7-8-74-14 W5M, Alberta, core #46, interval 2494-2502 ft., top of the Clearwater formation.

Hypotype: University of Alberta Paleontological Type Collection.

Remarks: Differs from Tritaxia athabascensis Mellon and Wall (1956) in showing the tendency to become biserial and having more chambers. It is almost identical to Tritaxia Z-5-A of Martin (1954) from the Clearwater type section.

EXPLANATION OF PLATE I

All specimens from Bear Villa #1, top
of the Joli Fou formation.

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Plate I

Joli Fou Foraminifera

EXPLANATION OF PLATE II

All specimens from Bear Villa #1, top
of the Joli Fou formation.

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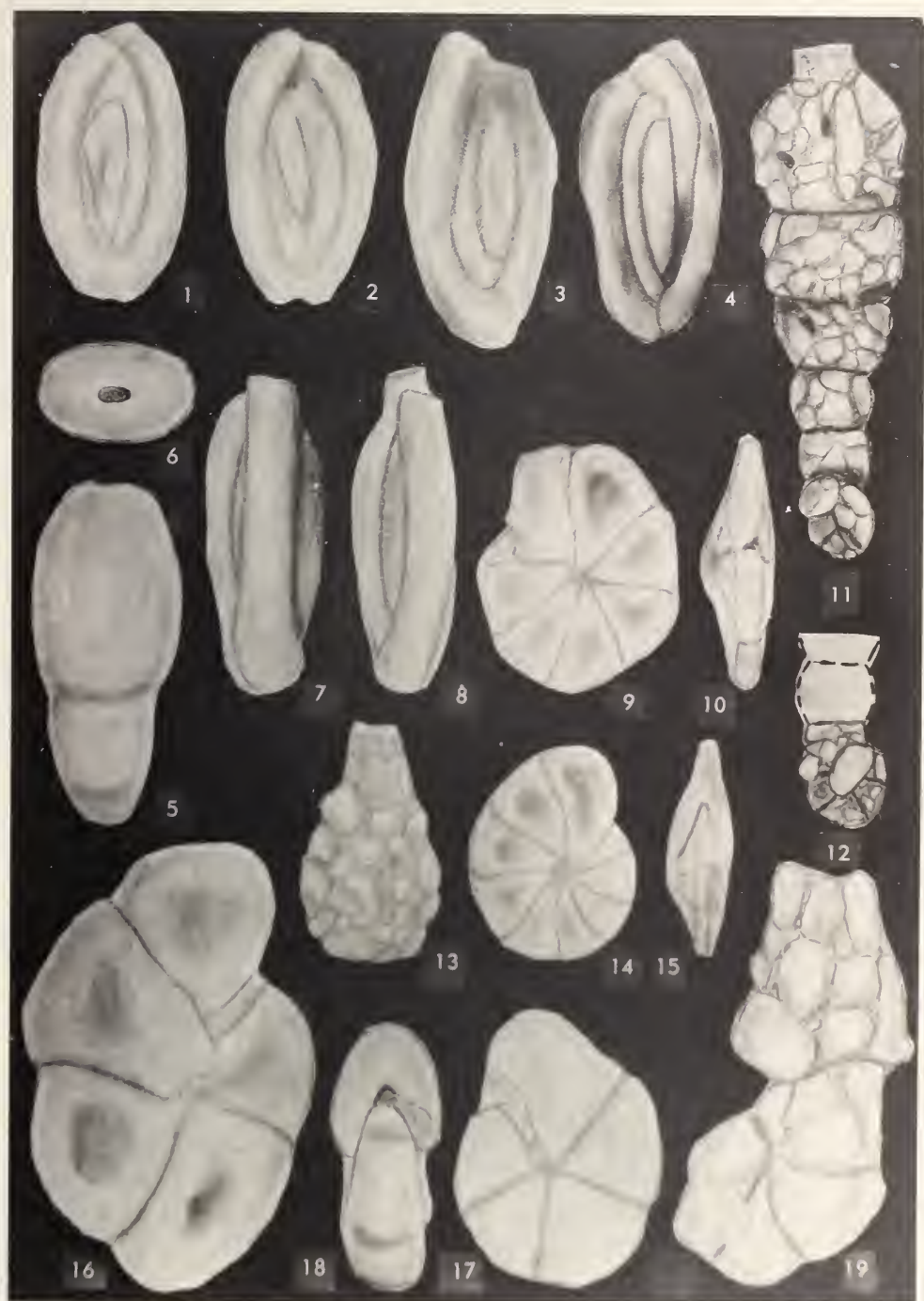


Plate II

Joli Fou Foraminifera

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All specimens from Bear Villa #1,
top of the Clearwater formation.

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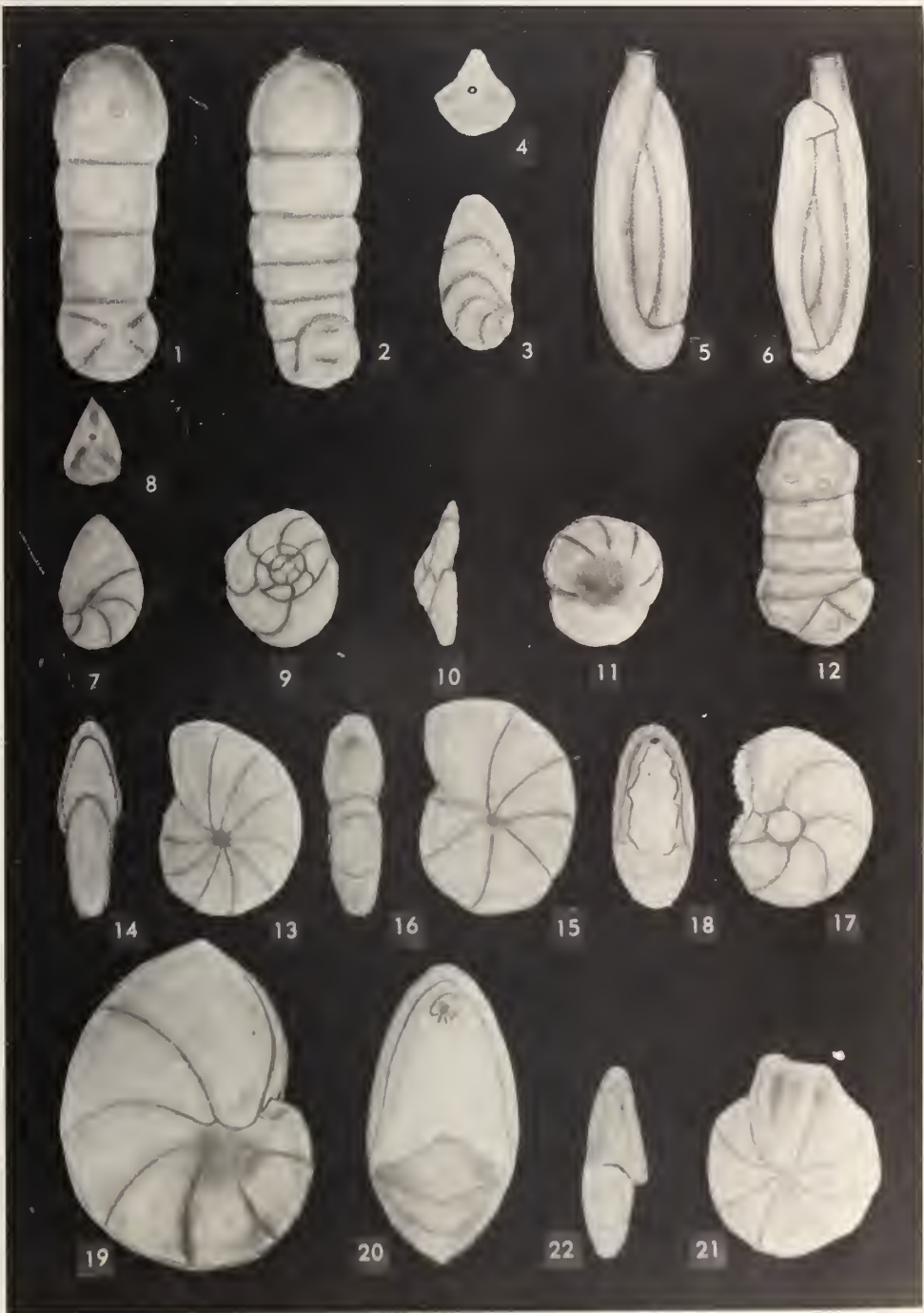


Plate III

Clearwater Foraminifera

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Plate IV

Clearwater Foraminifera

EXPLANATION OF PLATE V

All specimens from Bear Villa #1,
lower part of the Clearwater formation.

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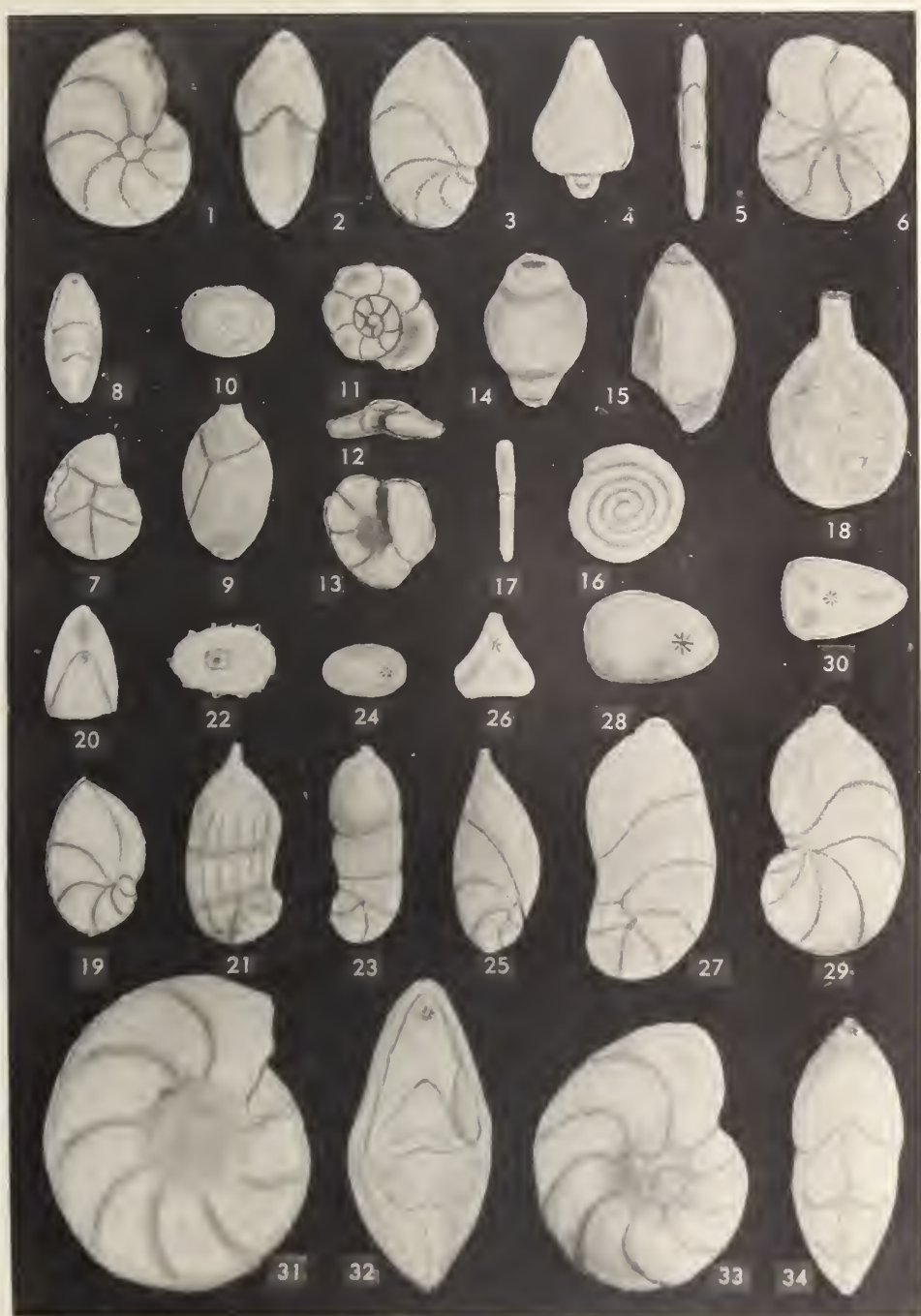


Plate V

Clearwater Foraminifera

APPENDIX - PART I

Recovery on Bear Villa #1 Cretaceous Cores

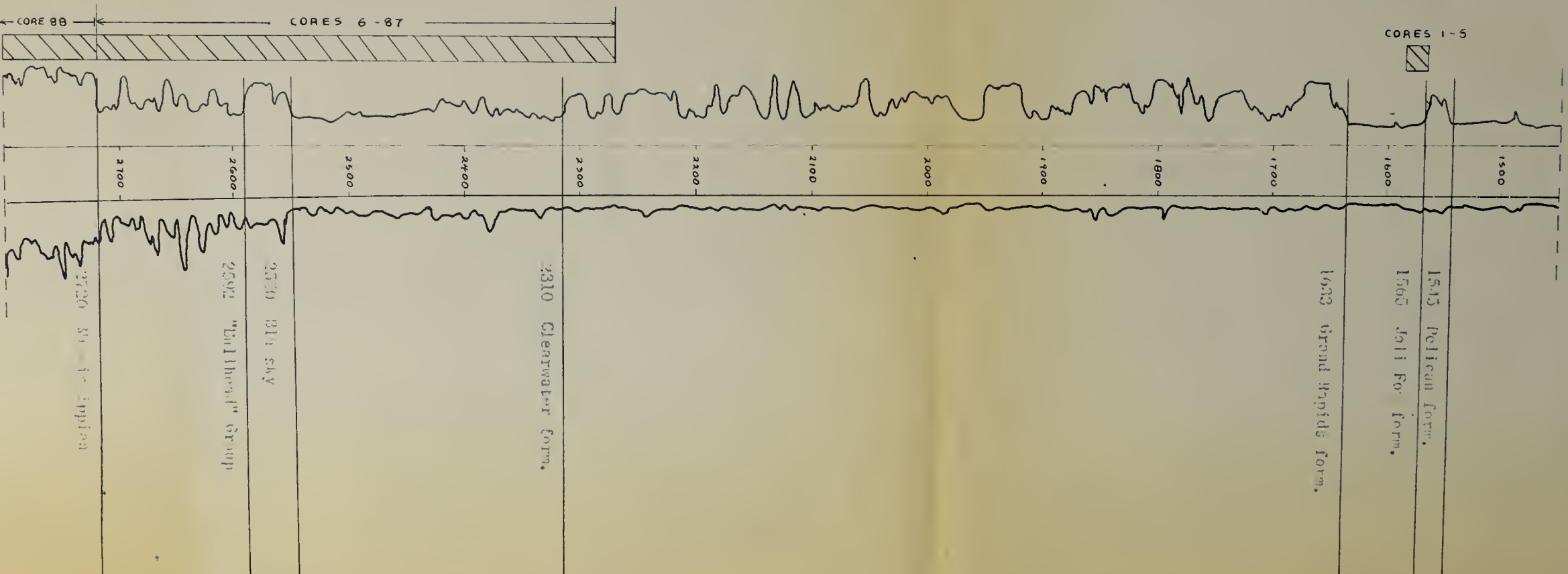
<u>Core #</u>	<u>Interval</u>	<u>Recovery</u>
1	1564-69	4' 9"
2	1569-71	0' 4"
3	1571-76	2' 0"
4	1576-80	3' 4"
5	1580-82	1' 0"
6	2270-76	6' 1"
7	2276-84	10' 0"
8	2284-92	7' 8"
9	2292-2300	8' 7"
10	2300-05	3' 8"
11	2305-13	1' 5"
12	2313-18	8' 0"
13	2318-23	2' 5"
14	2323-28	7' 0"
15	2328-33	5' 8"
16	2333-38	0' 2"
17	2338-43	0' 4"
18	2343-48	1' 4"
19	2348-51	2' 6"
20	2351-56	2' 8"
21	2356-61	3' 1"
22	2361-70	1' 6"

<u>Core #</u>	<u>Interval</u>	<u>Recovery</u>
23	2370-73	0' 6"
24	2373-75	0' 6"
25	2375-80	4' 8"
26	2380-85	4' 0"
27	2385-88	2' 5"
28	2388-93	4' 8"
29	2393-98	3' 3"
30	2398-2408	7' 0"
31	2408-17	5' 2"
32	2417-27	3' 0"
33	2427-35	1' 0"
34	2435-41	2' 0"
35	2441-47	0' 8"
36	2447-52	1' 6"
37	2452-55	0' 10"
38	2455-57	1' 4"
39	2457-62	5' 0"
40	2462-67	5' 4"
41	2467-72	4' 8"
42	2472-78	5' 5"
43	2478-84	1' 0"
44	2484-89	4' 0"
45	2489-94	4' 4"
46	2494-2502	7' 0"
47	2502-04	0' 6"

<u>Core #</u>	<u>Interval</u>	<u>Recovery</u>
48	2504-09	4' 0"
49	2509-17	9' 0"
50	2517-25	9' 0"
51	2525-33	8' 0"
52	2533-39	2' 8"
53	2539-45	2' 8"
54	2545-48	3' 0"
55	2548-53	1' 2"
56	2553-56	2' 0"
57	2556-59	3' 1"
58	2559-61	2' 7"
59	2561-66	4' 10"
60	2566-71	5' 2"
61	2571-76	5' 0"
62	2576-81	3' 4"
63	2581-86	5' 0"
64	2586-91	4' 0"
65	2591-96	3' 10"
66	2596-2601	3' 6"
67	2601-06	4' 1"
68	2606-11	5' 0"
69	2611-16	4' 6"
70	2616-21	2' 6"
71	2621-26	4' 6"

<u>Core#</u>	<u>Interval</u>	<u>Recovery</u>
72	2626-31	3' 0"
73	2631-36	4' 11"
74	2636-41	1' 6"
75	2641-46	5' 0"
76	2646-54	7' 1"
77	2654-62	6' 8"
78	2662-70	8' 0"
79	2670-78	7' 0"
80	2678-83	2' 0"
81	2683-88	5' 7"
82	2688-96	4' 5"
83	2696-2701	4' 0"
84	2701-06	3' 4"
85	2706-11	5' 8"
86	2711-18	4' 4"
87	2718-20	2' 0"

Bear Villa #1
 Lsd 7-7-74-14 WGM
 K.B. 1945



APPENDIX - PART II

Record and description of samples from Bear Villa #1,
taken by Wall and Mellon, Research Council of Alberta,
August 1953, and used in this thesis. Lithology by Nikiforuk.

- | | |
|----------|--|
| Core #1 | Composite sample; shale medium grey soft, micromicaceous, slightly silty. Two samples taken. |
| Core #2 | Composite sample; shale, dark grey, finely laminated, fissile. |
| Core #3 | Composite sample; shale, medium grey, silty, carbonaceous flecks, soft. |
| Core #4 | Composite sample; shale, medium grey, flaky, micromicaceous, non-calcareous. |
| Core #5 | Composite sample; shale, dark grey, flaky, waxy appearance, micromicaceous. |
| Core #6 | Top two feet of core; sandstone, salt and pepper, medium grained, angular quartz and chert fragments, glauconitic, slightly calcareous, good porosity. |
| Core #7 | Sample about 2279 feet; shale, medium grey, very silty, much carbonaceous material, flaky. |
| Core #8 | Sample about 2287 feet; shale, light grey, flaky, very silty, much carbonaceous material. |
| Core #8 | Sample 2289-97 feet; shale, medium grey, blocky, micromicaceous, silty, carbonaceous flecks. |
| Core #9 | Sample about 2297 feet; sandstone, salt and pepper, medium grained, angular quartz and black chert grains, some kaolinitic matrix, good porosity. |
| Core #12 | Composite sample; shale, dark grey, soft, massive, non-calcareous. |
| Core #13 | Composite sample; shale, medium grey, flaky, slightly silty, micromicaceous. |
| Core #14 | Composite sample; shale as in Core #13, with shale light, grey, blocky, carbonaceous flecks. |
| Core #15 | Near top of core; sandstone, light brown, fine-medium grained, some chert grains, glauconitic, very hard, calcareous cement, no porosity. |

- Core #19 Composite sample; shale, light grey-brown, massive, hard, micromicaceous, silty.
- Core #20 Composite sample; light grey, massive, bentonitic, micromicaceous.
- Core #21 Composite sample; shale, light grey, finely laminated, soft, micromicaceous.
- Core #22 Composite sample; shale, medium grey, massive, silty, carbonaceous flecks.
- Core #24 Sandstone, grey, fine to medium grained, some black chert grains, glauconitic, calcareous, kaolinitic matrix, very hard, no porosity.
- Core #25 Bottom half of core; sandstone, grey, fine grained, cherty, glauconitic, very hard, slightly calcareous, trace porosity.
- Core #28 Composite sample; shale, dark grey, massive, very silty, carbonaceous material.
- Core #30 Sample about middle of core; shale, light brown, soft, waxy appearance, silty in part.
- Core #32 Composite sample; shale, dark grey, soft, waxy appearance, massive, silty.
- Core #41 Composite sample; shale, light grey, silty, hard, laminated, many plant fragments.
- Core #42 Composite sample; shale, medium grey, laminated, silty, carbonaceous fragments.
- Core #43 Composite sample; shale, medium grey, flaky, micromicaceous.
- Core #44 Top two feet; shale, medium grey, blocky, micromicaceous, disseminated pyrite.
- Core #46 Bottom three feet; shale, dark grey, flaky, slightly calcareous, micromicaceous.
- Core #47 Poor recovery in core; shale, dark grey, flaky, soft, micromicaceous, slightly calcareous.
- Core #48 Composite sample; shale, brownish, slightly calcareous, massive, hard.
- Core #49 Top two feet; shale, black, massive, micromicaceous.
- Core #49 Lower seven feet; shale, black, massive, slightly silty, micromicaceous.

- Core #50 Top three feet; shale as in Core #49.
- Core #50 2518-22 feet; shale, black, soft, flaky, micromicaceous.
- Core #50 Lower three feet; shale, black, soft, massive, some carbonaceous material.
- Core #51 Bottom half of core; shale, black, flaky, massive in part, soft, micromicaceous.
- Core #52 Composite sample; shale, black, flaky, micromicaceous.
- Core #53 Composite sample; shale as in Core #52
- Core #54-55 Composite of both cores; shale, black, hard, flaky, micromicaceous.
- Core #57 Sandstone, brown, fine-medium grained, glauconitic, calcareous, oil stain?, some porosity, very hard.
- Core #63 Composite sample; shale, black, flaky, hard, silty in part, carbonaceous fragments.
- Core #64 Remainder of core; shale as in Core #63.
- Core #65 Small sample; shale, black, silty, hard, ostracods.
- Core #66 Small sample; shale, black, massive, silty, ostracods, few small pelecypods, some pyrite cubes.
- Core #67 Composite sample; shale, black, hard, massive, silty, ostracods, a few small pelecypods.
- Core #68 Basal foot of core; shale, black, massive, many small pelecypods, dessiminated pyrite.
- Core #69 Top two feet; shale, black, flaky, hard, silty.
- Core #75 Sandstone, salt and pepper, fine-medium grained, angular fragments, calcareous cement, very hard, no porosity.
- Core #87 Detrital zone; shale, black, soft, massive, waxy appearance.

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APPENDIX - PART IIIDescription of cuttings from Bear Villa #1,
by Nikiforuk.

0 - 660	Gravel, sandstone, surface cavings.
660 - 670	Gravel with shale grey, sandy, massive.
670 - 680	Gravel
680 - 690	Gravel, trace grey shale.
690 - 700	Shale, dark grey, arenaceous, massive, much cement cavings.
700 - 710	Gravel
710 - 720	Shale, dark grey-black, soft, arenaceous, massive.
720 - 730	Shale as above.
730 - 740	Shale, black, soft, massive, micromicaceous.
740 - 750	Shale as above.
750 - 760	Shale as above
760 - 770	Sample missing.
770 - 780	Shale, black, soft, flaky, massive.
780 - 790	Shale as above with fragments of an ironstone concretion.
790 - 800	Shale, black, flaky, soft, micromicaceous, many gypsum cleavage fragments, some blue-grey bentonite.
800 - 810	Shale, black, flaky, soft, trace blue-grey bentonite.
810 - 820	Shale, black, fissile, few calcareous white specks
820 - 830	Shale as above.
840 - 850	Shale, black, hard, blocky, calcareous.
850 - 860	Shale, black, fissile, calcareous white specks, some fragments of a calcareous concretion.
860 - 870	Shale as above with some thin limestone stringers.
870 - 880	Shale as above.

880 - 890	Shale, black, soft, with some disseminated pyrite.
890 - 900	Shale as above, some gravel cavings.
900 - 910	Shale, black, soft, massive, some disseminated pyrite.
910 - 920	Gravel cavings.
920 - 930	Shale, black, fissile, some red coloration due to sample being burned.
930 - 940	Shale as above.
940 - 950	Shale, black, soft, massive.
950 - 960	Shale, dark grey, soft, silty in part.
960 - 970	Shale, medium grey, blocky, micromicaceous
970 - 980	Shale, black, massive, silty, red coloration due to burning.
980 - 990	Shale as above.
990 - 1000	Shale, dark grey, silty, burned red.
1000 - 1010	Shale, grey, silty in part, some calcareous concretion fragments.
1010 - 1020	Shale as above with concretion fragments.
1020 - 1030	Shale, grey-brown, soft, massive, silty.
1030 - 1040	Shale as above.
1040 - 1050	Shale as above.
1050 - 1060	Shale, black, fissile, soft, micromicaceous.
1060 - 1070	Shale, dark grey-black, soft, massive, silty.
1070 - 1080	Shale, black, soft, flaky, micromicaceous.
1080 - 1090	Shale, dark grey, blocky to massive, micromicaceous.
1090 - 1100	Shale as above.
1100 - 1110	Shale as above.
1110 - 1120	Shale, dark grey, soft, silty, massive.
1120 - 1130	Shale, black, very hard, blocky, calcareous, silty.

1130 - 1140	Shale, medium grey, silty, blocky, hard.
1140 - 1150	Shale as above.
1150 - 1160	Shale as above.
1160 - 1170	Shale, medium grey, silty, massive, some disseminated pyrite.
1170 - 1180	Shale as above with shale, black, hard, calcareous, silty.
1180 - 1190	Shale, black, flaky, micromicaceous, soft.
1190 - 1200	Shale as above.
1200 - 1210	Shale, black, fissile, micromicaceous.
1210 - 1220	Shale, dark grey, massive to blocky, micromicaceous.
1220 - 1230	Shale as above.
1230 - 1240	Shale, black, soft, blocky, flaky in part, micromicaceous.
1240 - 1250	Shale as above with abundant calcareous concretion fragments.
1250 - 1260	Shale, light grey, fissile, flaky, micromicaceous.
1260 - 1270	Shale as above.
1270 - 1280	Shale as above with ironstone concretion fragments.
1280 - 1290	Shale, medium grey, soft, flaky to blocky, micromicaceous.
1290 - 1300	Shale as above.
1300 - 1310	Shale, light grey, blocky, soft, with white bentonite.
1310 - 1320	Shale, dark grey, flaky, micromicaceous.
1320 - 1330	Shale, black, sooty, finely fissile, micromicaceous, carbonaceous fragments.
1330 - 1340	Shale as above, some grey bentonite.
1340 - 1350	Shale, dark grey, flaky, micromicaceous.
1350 - 1360	Shale as above.

1360 - 1370	Shale as above.
1370 - 1380	Shale, medium grey, flaky, micromicaceous with red-brown ironstone.
1380 - 1390	Shale, black, splintery, micromicaceous, sooty.
1390 - 1400	Shale, dark grey-black, flaky, splintery in part, with red-brown ironstone.
1400 - 1410	Shale, black, soft, flaky.
1410 - 1420	Shale as above.
1420 - 1430	Shale as above.
1430 - 1440	Shale, black, flaky, soft, some red streaks.
1440 - 1450	Shale, dark grey, massive, silty.
1450 - 1460	Shale, black, flaky, soft, silty in part.
1460 - 1470	Shale, black, flaky, blocky in part, silty in part.
1470 - 1480	Shale as above.
1480 - 1490	Shale as above.
1490 - 1500	Shale, black, flaky, splintery in part, micromicaceous.
1500 - 1510	Shale as above, trace grey bentonite.
1510 - 1520	Shale, black, flaky, blocky in part, micromicaceous.
1520 - 1530	Shale as above.
1530 - 1540	Shale, black, massive, micromicaceous, soft.
1540 - 1550	Shale, as above with siltstone, grey, massive.
1550 - 1560	Sand, white, coarse grained, unconsolidated, rounded - sub-rounded, slightly frosted quartz grains, abundant sand-size grains and rounded pebbles of black and very dark green chert, no cement, abundant black shale cavings, excellent porosity.
1560 - 1564	Sand as above.
1564 - 1569	Sandstone, white, coarse grained, rounded, frosted quartz grains, slightly cemented, excellent porosity, with abundant gravel and shale cavings.

1569 - 1571	Shale, black, flaky to blocky, micromicaceous.
1571 - 1576	Shale as above.
1576 - 1580	Shale as above, some ironstone, few chert pebble cavings.
1580 - 1590	Shale, black, flaky, blocky in part, micromicaceous.
1590 - 1600	Shale, dark grey, flaky, soft, some shale black as above.
1600 - 1610	Shale, medium grey, flaky, finely fissile in part, micromicaceous, soft.
1610 - 1620	Shale as above, silty in part, some sand cavings.
1620 - 1630	Shale, black, flaky, micromicaceous.
1630 - 1640	Shale as above.
1640 - 1650	Shale, dark grey, fissile, soft, micromicaceous, some sand, loose coarse grained, dark green chert grains.
1650 - 1660	Shale, dark grey fissile, soft, with sand, coarse grained, rounded to sub-rounded quartz, chert, garnet and feldspar? grains, no cement, few pyrite particles.
1660 - 1670	Shale, medium grey, blocky, micromicaceous, soft, with trace sand as above.
1670 - 1677	Shale as above with sand, medium-coarse grained, sub-rounded to angular, slightly frosted quartz and chert grains, many large rounded pebbles of black and dark and light green chert, few glauconite? grains, unconsolidated.
1677 - 1690	Shale, dark grey-black, blocky, silty, with sandstone, salt and pepper, medium grained, calcareous cement, tight.
1690 - 1700	Shale, dark grey, flaky to blocky, silty, few carbonaceous fragments.
1700 - 1710	Shale, dark grey, micromicaceous, blocky, trace red, hematite? streaks and spots.
1710 - 1720	Shale as above, with sandstone, grey, salt and pepper, medium grained sub-angular quartz and black chert grains, some muscovite flakes, minor kaolinite matrix, fair porosity.

- 1720 - 1730 Shale, dark grey, flaky to blocky, micromicaceous, silty, with sandstone, grey medium grained, shaly poor porosity.
- 1730 - 1740 Shale, dark grey, blocky, carbonaceous spots and streaks, with sandstone, grey, salt and pepper, medium grained, sub-rounded quartz and black chert fragments, silty matrix, calcareous, very poor porosity.
- 1740 - 1750 Shale, medium grey, blocky, abundant carbonaceous fragments, very silty, arenaceous.
- 1750 - 1760 Shale as above.
- 1760 - 1770 Shale, dark grey, micromicaceous, flaky, carbonaceous flecks.
- 1770 - 1780 Shale as above.
- 1780 - 1790 Shale, light grey, flaky to finely fissile.
- 1790 - 1800 Sandstone, grey, salt and pepper, coarse grained, angular fragments of quartz, black chert, and feldspar, poor sorting, calcareous cement, tight.
- 1800 - 1810 Sandstone as above.
- 1810 - 1820 Shale, medium grey, blocky, silty, abundant carbonaceous fragments.
- 1820 - 1830 Shale as above, with grey bentonite, with sandstone, grey, medium grained, shaly, fair porosity.
- 1830 - 1840 Sandstone, grey, salt and pepper, sub-rounded to angular, poor sorting, calcareous cement, some glauconite grains, poor porosity.
- 1840 - 1850 Shale, medium grey, flaky to finely fissile, slightly arenaceous.
- 1850 - 1860 Shale as above, with abundant rounded, black chert pebbles, cavings?.
- 1860 - 1870 Chert pebbles as above, with sandstone, salt and pepper, medium grained, sub-rounded to angular, quartz and black chert grains, few glauconite grains, very poor porosity.
- 1870 - 1880 Shale, black, micromicaceous, blocky, some sandstone as above.
- 1880 - 1890 Shale as above.

1900 - 1901	1900 - 1901	1900 - 1901
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1996 - 1997	1996 - 1997	1996 - 1997
1998 - 1999	1998 - 1999	1998 - 1999
2000 - 2001	2000 - 2001	2000 - 2001

1890 - 1900	Shale, black, flaky to blocky, micromicaceous, carbonaceous flecks.
1900 - 1910	Shale as above.
1910 - 1920	Shale, medium grey, micromicaceous, blocky, carbonaceous fragments.
1920 - 1930	Shale as above, burned red.
1930 - 1940	Shale, black, micromicaceous, fissile to blocky, with sandstone, grey, medium grained, silty in part, fair porosity.
1940 - 1950	Shale, medium grey, blocky to massive, micromicaceous, silty, some biotite flakes.
1950 - 1960	Shale, dark grey, finely fissile, micromicaceous.
1960 - 1970	Shale as above.
1970 - 1980	Shale as above, with sandstone, medium-coarse grained, unconsolidated, sub-rounded quartz and black chert grains, excellent porosity.
1980 - 1990	Sandstone as above.
1990 - 2000	Shale, dark grey, flaky to blocky, soft.
2000 - 2010	Shale as above.
2010 - 2020	Shale, black, hard, blocky, micromicaceous, carbonaceous flecks.
2020 - 2030	No sample.
2030 - 2040	Siltstone, buff, blocky, arenaceous.
2040 - 2050	Siltstone as above, with shale, dark grey, flaky, carbonaceous flecks, silty.
2050 - 2060	Shale, light grey, flaky, micromicaceous, with intercalated siltstone, light grey, massive, carbonaceous flecks.
2060 - 2070	Sandstone, grey, salt and pepper, medium grained, hard, calcareous cement, no porosity.
2070 - 2080	Siltstone, grey-buff, massive, with shale, dark grey, flaky, carbonaceous flecks, trace sandstone as above.
2080 - 2090	Shale and siltstone as above.
2090 - 2100	No sample.

2100 - 2110	Siltstone, light grey, massive, abundant carbonaceous fragments.
2110 - 2120	Shale, black to dark brown, hard calcareous, silty.
2120 - 2130	Shale, dark grey, micromicaceous, flaky to blocky.
2130 - 2140	Shale as above.
2140 - 2150	Shale, black, flaky, soft, micromicaceous.
2150 - 2160	Shale, light grey, massive to flaky, micromicaceous, silty carbonaceous flecks, grading to siltstone in part.
2160 - 2170	Shale as above, with sandstone, grey, medium grained, angular to sub-rounded fragments, poor sorting, many black chert grains, few glauconite grains, fair porosity.
2170 - 2180	Shale, black, hard, blocky, micromicaceous.
2180 - 2190	Shale as above, abundant brown ironstone.
2190 - 2200	Shale, dark grey, flaky, soft, crumbly, micromicaceous.
2200 - 2210	Shale as above, some blue-grey bentonite.
2210 - 2220	Shale, dark grey, crumbly, silty, blocky in part.
2220 - 2230	Shale as above, many gravel cavings.
2230 - 2240	Sandstone, grey, medium-fine grained, poorly sorted, some chert grains, few glauconite grains, much yellow limonite? staining, fair porosity.
2240 - 2250	Shale, black, blocky, micromicaceous, silty in part, with sandstone as above.
2250 - 2260	Shale as above.
2260 - 2270	Shale, medium grey, blocky, with siltstone, grey, massive, carbonaceous flecks.
2270 - 2280	Sample missing.
2280 - 2290	Shale, dark grey, flaky, crumbly, soft, trace sandstone, unconsolidated, medium grained, cherty, glauconitic.
2290 - 2300	Shale, dark grey, flaky, crumbly, soft, some carbonaceous material.

2300 - 2313	Shale as above.
2313 - 2323	Shale as above, with sandstone, grey, fine grained, glauconitic, cherty, calcareous cement, no porosity.
2323 - 2334	Sandstone as above.
2334 - 2348	Shale, dark grey-black, finely fissile, soft.
2348 - 2360	Shale, light grey, blocky, silty.
2360 - 2370	Shale, dark grey, blocky, splintery in part, micromicaceous
2370 - 2380	Sandstone, grey, salt and pepper, fine to medium grained, poorly sorted, glauconitic, slightly calcareous, poor porosity.
2380 - 2388	Shale, medium grey, blocky to massive, silty.
2388 - 2398	Shale, medium grey, flaky, crumbly, micromicaceous, soft.
2398 - 2408	Shale as above.
2408 - 2417	Shale as above, with sandstone, grey, fine grained minor black chert, limonite blobs, calcareous, no porosity
2417 - 2427	Sandstone as above.
2427 - 2441	Sandstone as above, with shale, dark grey, flaky, with siltstone, grey, massive.
2441 - 2452	Shale, medium grey, massive to flaky, silty in part, micromicaceous.
2452 - 2462	Shale as above.
2462 - 2472	Shale, dark grey, finely fissile, carbonaceous material, and ironstone.
2472 - 2478	Shale as above.
2478 - 2489	Shale, dark grey to black, massive, crumbly.
2489 - 2502	Shale, medium grey, massive, soft, with abundant blue-grey bentonite.
2502 - 2509	Shale as above.
2509 - 2525	Shale, dark grey, flaky to finely fissile.
2525 - 2539	Shale as above.

- 2539 - 2548 Shale, dark grey to black, splintery in part, silty, abundant ironstone.
- 2548 - 2556 Shale, medium grey, blocky, silty, with sandstone, brown, medium grained, angular to sub-rounded quartz and chert grains, much glauconite, Fe staining, fair porosity.
- 2556 - 2562 Sandstone as above.
- 2562 - 2576 Shale, medium grey, blocky, silty, trace sandstone as above.
- 2576 - 2586 Shale as above, with sandstone, brown, medium grained, well sorted, iron stained, good porosity, slightly calcareous, with brown ironstone.
- 2586 - 2596 Shale, light brown, blocky to splintery, waxy appearance.
- 2596 - 2606 Shale, dark grey, blocky, micromicaceous, carbonaceous flecks
- 2606 - 2611 Shale as above.
- 2611 - 2621 Shale as above, with siltstone, light brown, massive, pyrite flecks.
- 2621 - 2631 Shale, brown, massive, with siltstone, brown, massive, arenaceous.
- 2631 - 2641 Siltstone as above, with shale, dark grey, finely fissile, crumbly.
- 2641 - 2654 Siltstone, dark grey, hard, calcareous, some disseminated pyrite.
- 2654 - 2662 Siltstone as above, with sandstone, grey, fine - medium grained, calcareous cement, some chert grains, no porosity.
- 2662 - 2670 Sandstone as above, with siltstone, brown, massive, arenaceous.
- 2670 - 2678 Shale, black, finely fissile, soft, crumbly.
- 2678 - 2688 Shale as above.
- 2688 - 2698 Shale, dark grey, flaky to finely fissile, soft, crumbly, micromicaceous.
- 2698 - 2707 Shale as above.

- 2707 - 2718 Shale, dark grey, blocky, soft, crumbly.
- 2718 - 2720 Shale as above, trace milky-grey chert fragments.
- 2720 Top of the Mississippian.

SUMMARY

<u>Formation</u>	<u>Thickness</u>	<u>Top in Bear Villa #1 Well</u>
Pelican	20'	1545 (+400)
Joli Fou	68'	1565 (+380)
Grand Rapids	677'	1633 (+312)
Clearwater	282'	2310 (-365)
Bluesky	42'	2550 (-605)
"Bullhead" Group	128'	2592 (-647)
Mississippian	-	2720 (-775)

The term "Bullhead" Group, as used above, includes all the strata from the base of the Bluesky glauconitic sand to the top of the Mississippian. The only microfossils obtained from this horizon were ostracods. Inasmuch as Lower Cretaceous ostracods are not zoned, no dating of the "Bullhead" Group was made. However the "Bullhead" Group may possibly be a correlative of the McMurray formation. Only a few elements from Trollope's (1951) Lower Loon River microfauna have been identified in the Bear Villa #1 section. It may be possible that the "Bullhead" Group represents the nearshore deposits that correlate with the lower part of the Loon River formation. If the latter is so, the use of the term "Bullhead" is possibly misleading.

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